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AN/473

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Approved by the Secretary General
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FOREWORD

The safety of civil aviation is the major objective of the International Civil Aviation Organization (ICAO). Considerable progress has been made in securing one of the highest levels of safety in contemporary socio-technical production systems, but additional improvements in safety are considered necessary. It has long been known that the majority of aviation safety breakdowns result from less than optimum interaction between the different components of the aviation system and the people who operate that system and serve as a last line of defence to preserve aviation safety. Therefore, any advance in this regard can have a significant impact on the improvement of aviation safety.

This was recognized by the ICAO Assembly, which in 1986 adopted Resolution A26-9 on Flight Safety and Human Factors. As a follow-up to that Assembly Resolution, the Air Navigation Commission formulated the following task:

> "To improve safety in aviation by making States more aware and responsive to the importance of Human Factors in civil aviation operations through the provision of practical Human Factors materials and measures, developed on the basis of experience in States, and by developing and recommending appropriate amendments to existing material in Annexes and other documents with regard to the role of Human Factors in the present and future operational environments. Special emphasis will be directed to the Human Factors issues that may influence the design, transition and in-service use of the future ICAO CNS/ATM systems."

One of the methods chosen to implement Assembly Resolution A26-9 was the publication of guidance material, including manuals and a series of digests that address various aspects of Human Factors and their contribution to aviation safety. These documents are intended primarily for use by States to increase the awareness of their personnel about the contribution of Human Factors and human performance to aviation safety. The target audience is managers both of civil aviation administrations and industry, including safety, training and operational managers. The target audience also includes regulatory bodies, safety and investigation agencies and training establishments, as well as senior and middle non-operational industry management.

The publication of this manual is furthermore a result of Recommendation 2/5 of the Eleventh ICAO Air Navigation Conference, held in Montreal in 2003, which reads: "That ICAO initiate studies on the development of guidance material for the monitoring of safety during normal air traffic service operations, taking into account, but not limited to, the line operations safety audit (LOSA) programmes which have been implemented by a number of airlines."

This manual introduces the Normal Operations Safety Survey (NOSS), a methodology for capturing safety data during normal air traffic control (ATC) operations. The NOSS methodology is based on the Threat and Error Management (TEM) framework and is a safety management tool to monitor safety during normal aviation operations. Monitoring safety in normal operations is an essential activity within the safety management systems of air traffic services (ATS) provider organizations, and NOSS is proposed as a suitable way to do this. In introducing NOSS, the manual also presents the latest information available to international civil aviation on the control of systemic error in operational environments, from the perspective of safety management. Its target audience includes senior safety, training and operational personnel in ATS and regulatory bodies.

ACRONYMS AND ABBREVIATIONS

ACC	Area control centre
ADC	Aerodrome control
ATC	Air traffic control
ATCO	Air traffic control officer
ATS	Air traffic services
ATSP	Air traffic services provider
CAA	Civil aviation authority
CNS/ATM	Communication, navigation and surveillance/air traffic management
EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
IFATCA	International Federation of Air Traffic Controllers' Associations
LOSA	Line operations safety audit
NOSS	Normal Operations Safety Survey
OJT	On-the-job-training
R/T	Radiotelephony
RVSM	Reduced vertical separation minima
SMC	Surface movement control
SMS	Safety management system
TEM	Threat and Error Management
TLC	The LOSA collaborative
VFR	Visual flight rules

INTRODUCTION

1. Aviation is arguably the safest mode of mass transportation and one of the safest socio-technical production systems in the history of humankind. This achievement acquires particular relevance when considering the age of the aviation industry, which is measured in decades, as compared to other industries whose histories span centuries. It is a tribute to the aviation safety community and its unrelenting endeavours that in a mere century aviation has progressed, from a safety perspective, from a fragile system to the first ultra-safe system in the history of transportation.

2. In retrospect, the history of the progress of aviation safety can be divided into three distinct eras, each with fundamentally different attributes.

3. In the first era, which spans from the pioneering days of the early 1900s until approximately the late 1960s, from a safety standpoint aviation could be characterized as a fragile system. Safety breakdowns, although certainly not daily occurrences, were not infrequent. It was then only logical that safety understanding and prevention strategies were derived mainly from accident investigation. The safety focus was on individuals and individual risk management, which in turn built upon the foundations provided by intensive training programmes.

4. During the second era, from the early 1970s until the mid-1990s, aviation became a safe system. The frequency of safety breakdowns diminished significantly, and a more all-encompassing understanding of safety, which looked beyond individuals to the broader system, was progressively developed. This naturally led to a search for safety lessons beyond accident investigation, and thus the emphasis shifted to the investigation of incidents. This shift to a broader perspective of safety and incident investigation was accompanied by the massive introduction of technology as the only way to achieve increased system production demands, and an ensuing multiple-fold increase in safety regulations.

5. From the mid-1990s to the present day, aviation entered its third safety era, becoming an ultra-safe system (i.e. a system that experiences less than one catastrophic safety breakdown in every one million production cycles). Overall, accidents became infrequent to the extent of turning into anomalies in the system. Incidents became fewer and far apart. Thus, the broad systemic safety perspective that had started to emerge during the previous era was further pursued using a business-like approach to the management of safety, based upon the routine collection and analysis of daily operational data. This business-like approach to safety underlies the introduction of safety management systems (SMS). Figure I-1 illustrates the evolution of safety discussed above.

6. The evolution in safety thinking was accompanied by an evolution in terms of sources of safety data and safety data collection. Up until the mid-1990s, safety data collection was mostly reactive. Eventually what began as "forensic" systems for safety data collection, in which the data were derived from the investigation of accidents and major incidents, developed into systems where safety data from less severe events became available through mandatory and voluntary reporting programmes. Nevertheless, these newer systems were still reactive: safety data became available only after safety deficiencies triggered a certain event or occurrence.

7. In observing the business-like approach to safety underlying SMS, it became evident that in order to sustain safety in the ultra-safe system, a proactive data collection methodology, to complement the existing reactive systems, was required. To that end, electronic data acquisition systems and non-jeopardy self-reporting programmes were introduced to collect safety data from normal operations. The latest addition to these proactive safety data collection methodologies are data acquisition systems that are based on direct observation of operational personnel during normal operations.

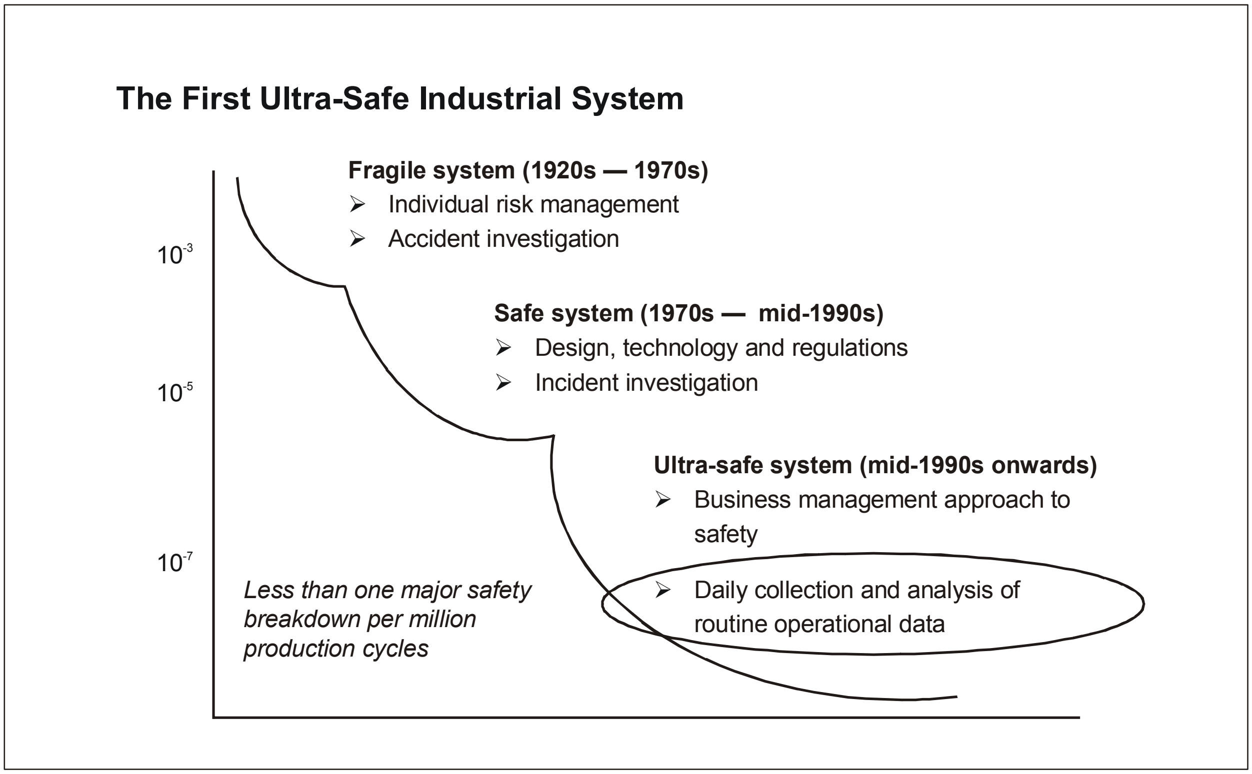

Figure I-1. The evolution of safety in aviation

8. There is solid justification for collecting safety data from normal aviation operations. In spite of its safety excellence, the aviation system, just like any other human-made system, is far from perfect. Aviation is an open system, i.e. it operates in an uncontrolled environment and is subject to environmental disturbances. It is simply not feasible to design from scratch an open system that is perfect, if for no other reason than that it is impossible to anticipate all potential operational interactions between people, technology and the context in which aviation operations take place.

9. System designers anticipate plausible scenarios of operational interactions, and thus an initial system design can be conceptually thought of as a solid straight line that embodies the three basic assumptions of system design: the technology needed to achieve the system production goals; the training necessary for people to operate the technology; and the regulations that dictate system behaviour. Such assumptions represent the baseline (or ideal) system performance. Once operationally deployed, the system performs as designed most of the time, but oftentimes operational performance separates from baseline performance. In other words, a gradual drift from the baseline performance expected according to the system's design assumptions occurs as the inevitable consequence of real-life operations.

10. The reasons for this drift are multiple-fold: technology that does not operate as predicted; procedures that cannot be executed under dynamic operational conditions; regulations that do not reflect contextual limitations; introduction of subtle changes to the system after its design; addition of new components to the system without an appropriate safety assessment; or the interaction with other systems. The fact remains, however, that in spite of all these potential shortcomings, people operating inside the drift make the system work on a daily basis, improving or circumventing system shortcomings through local adaptations and personal strategies that embody the collective domain expertise of aviation operational professionals, i.e. “the way we do business here, beyond what the book says”.

11. Capturing what takes place within the drift through formal means, i.e. methodically capturing collective domain expertise, holds considerable learning potential about successful safety adaptations, which can be fed back into system design improvements if obtained in a principled manner. On the negative side, unchecked deployment of local adaptations and personal strategies may allow the drift to develop too far from the expected baseline performance, to the extent that an incident or an accident becomes a possibility. Figure I-2 illustrates the notion of "operational drift" (i.e. a drift that is a consequence of daily operations).

12. From a safety management perspective, monitoring normal operations makes it possible to catch the "drift" from the baseline performance of the system close to its inception, and long before incidents or accidents occur. The result is not only improved safety, but also considerable improvement in system efficiency.

13. This manual provides guidance on a direct observation data acquisition method for air traffic control called Normal Operations Safety Survey (NOSS). This method was developed with the assistance of the ICAO NOSS Study Group and is based on a similar method used in the flight deck environment — LOSA (line operations safety audit). Although NOSS is different from LOSA in many respects, there are also similarities in the methodology applied by both. NOSS and LOSA are both based on the Threat and Error Management (TEM) framework.

14. TEM is a conceptual framework that assists in understanding, from an operational perspective, the interrelationship between safety and human performance in dynamic and challenging operational contexts. The TEM framework focuses simultaneously on the operational context and the people discharging operational duties in such a context. The framework is descriptive and diagnostic of both human and system performance.

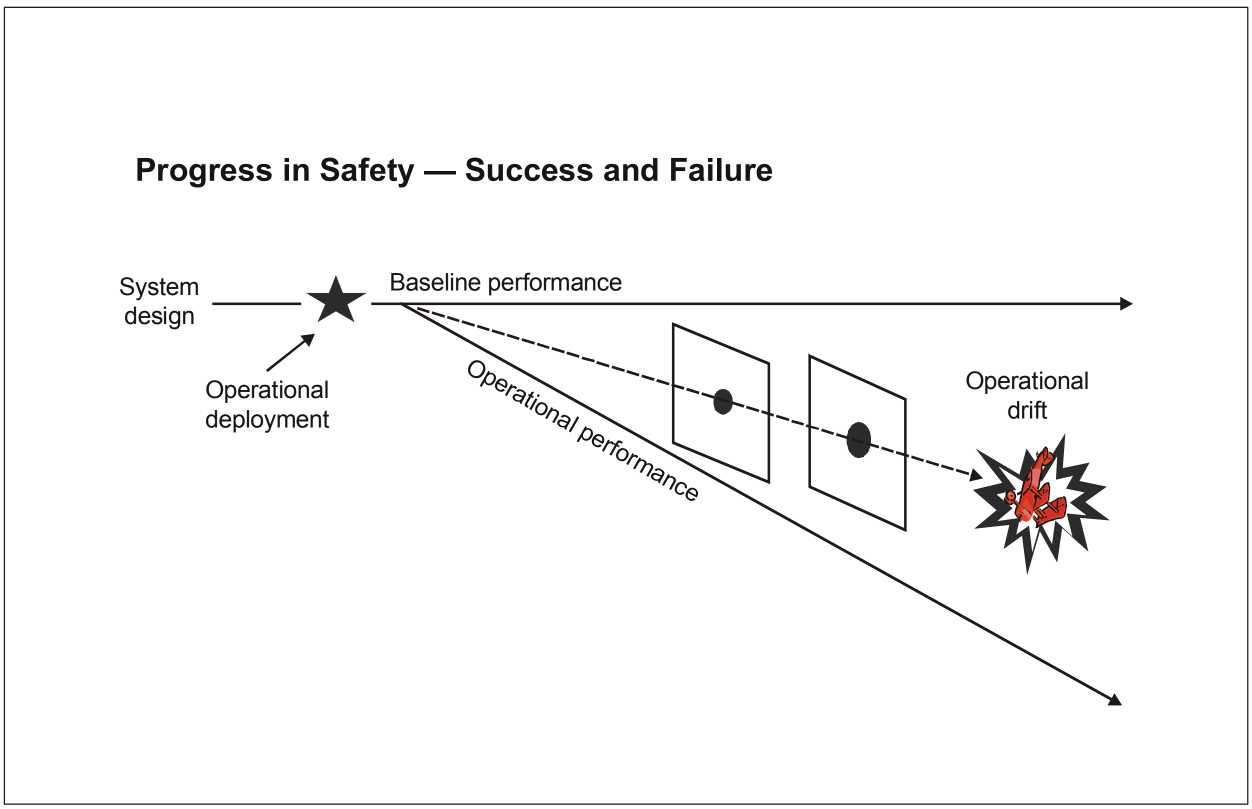

Figure I-2. The practical drift from a system's baseline performance

15. The use of TEM thus provides a common framework that can assist in addressing multi-disciplinary issues in the aviation industry through the exchange and analysis of safety data from normal aviation operations.

16. The chapters of this manual cover topics including a description of NOSS, the ten NOSS operating characteristics, preparing for a NOSS, observer training and data collection, data verification process, data analysis and production of the final report, and using the NOSS results in the organization.

17. ICAO acknowledges the assistance of the NOSS Study Group[1] in the production of this manual.

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1. The NOSS Study Group comprised representatives of (in alphabetical order): Airservices Australia, Airways Corporation New Zealand, Deutsche Flugsicherung (DFS), EUROCONTROL, IFATCA, NAV CANADA, UK CAA, US FAA. The University of Texas at Austin, through its Human Factors Research Project, provided scientific advice to the NOSS Study Group.

Chapter 1

BACKGROUND AND JUSTIFICATION

1.1 A BRIEF DESCRIPTION OF NORMAL OPERATIONS SAFETY SURVEY (NOSS)

1.1.1 NOSS is a method for the collection of specific safety data during normal air traffic control (ATC) operations. ATC staff from within an organization are trained in approximately a one-week period to perform unobtrusive over-the-shoulder observations in the operational environment. The observations typically take place over a period of one to two months and last around one hour each.

1.1.2 After each session the observers write a detailed narrative in which they identify the threats, errors and undesired states they observed and how these were managed. The combined narratives are subsequently analysed to provide the organization with a report in which a detailed profile is given of the most prevalent threats, errors and undesired states in their operation and how these are managed.

1.1.3 This information will assist the air traffic services provider (ATSP) to effectively select targets for safety enhancements, e.g. by highlighting topics that could be addressed through its safety management system (SMS). It will also show what the strong points are in the organization with respect to the management of threats, errors and undesired states. That information can be used to expand successful safety programmes or strategies that exist within the organization and to determine where safety resources should be focused.

Note.— A comprehensive description of the safety management process is provided in the ICAO Safety Management Manual *(Doc 9859), Chapter 5.*

1.1.4 NOSS should be seen as a cyclic programme within the safety management activities of an ATSP (see Figure 1-1). After implementing specific safety changes in the organization as a result of a NOSS, a second or follow-up NOSS can be scheduled to take place some time later, to obtain quantitative information about the effect of the changes made. Based on the experience of airlines after a LOSA, a period of three or four years between successive NOSS cycles seems to allow sufficient time for changes to take effect. However because of the frequent repetition of certain ATC operations that may be the subject of changes made, the effect may already be measurable after a shorter period. The follow-up NOSS will most likely generate further targets for safety enhancements that the ATSP can act upon.

1.2 FRAMEWORK FOR NOSS

1.2.1 NOSS is based on the Threat and Error Management (TEM) framework. TEM is a conceptual framework that assists in understanding, from an operational perspective, the interrelationship between safety and human performance in dynamic and challenging operational contexts. A detailed introduction to TEM in ATC is provided in Appendix A to this manual, as well as in ICAO Circular 314 — *Threat and Error Management (TEM) in Air Traffic Control*.

1.2.2 The TEM framework focuses simultaneously on the operational context and the people discharging operational duties in such a context. The framework is descriptive and diagnostic of both human and system performance. It is descriptive because it captures human and system performance in the normal operational context, resulting in realistic descriptions. It is diagnostic because it allows quantification of the complexities of the operational context in relation to the description of human performance in that context, and vice versa.

> "The use of the TEM framework has allowed us to gain a greater understanding of some areas of our operation in an unbiased and structured way that was previously not available. The approach that the framework ensures has changed the focus of some of our system design from attempting to control errors to one that endeavours to control the threats (i.e. controlling potential hazards rather than controlling outcomes). This is a significant advancement in our approach to risk management that has also been adopted in our incident investigation processes."
>
> ATSP

1.3 NOSS AND THE ORGANIZATIONAL SAFETY FRAMEWORK

1.3.1 ICAO Annex 11 — *Air Traffic Services,* 2.27.3, contains a provision that States shall require that an air traffic services provider implements a safety management system acceptable to the State that, as a minimum:

a) identifies safety hazards;

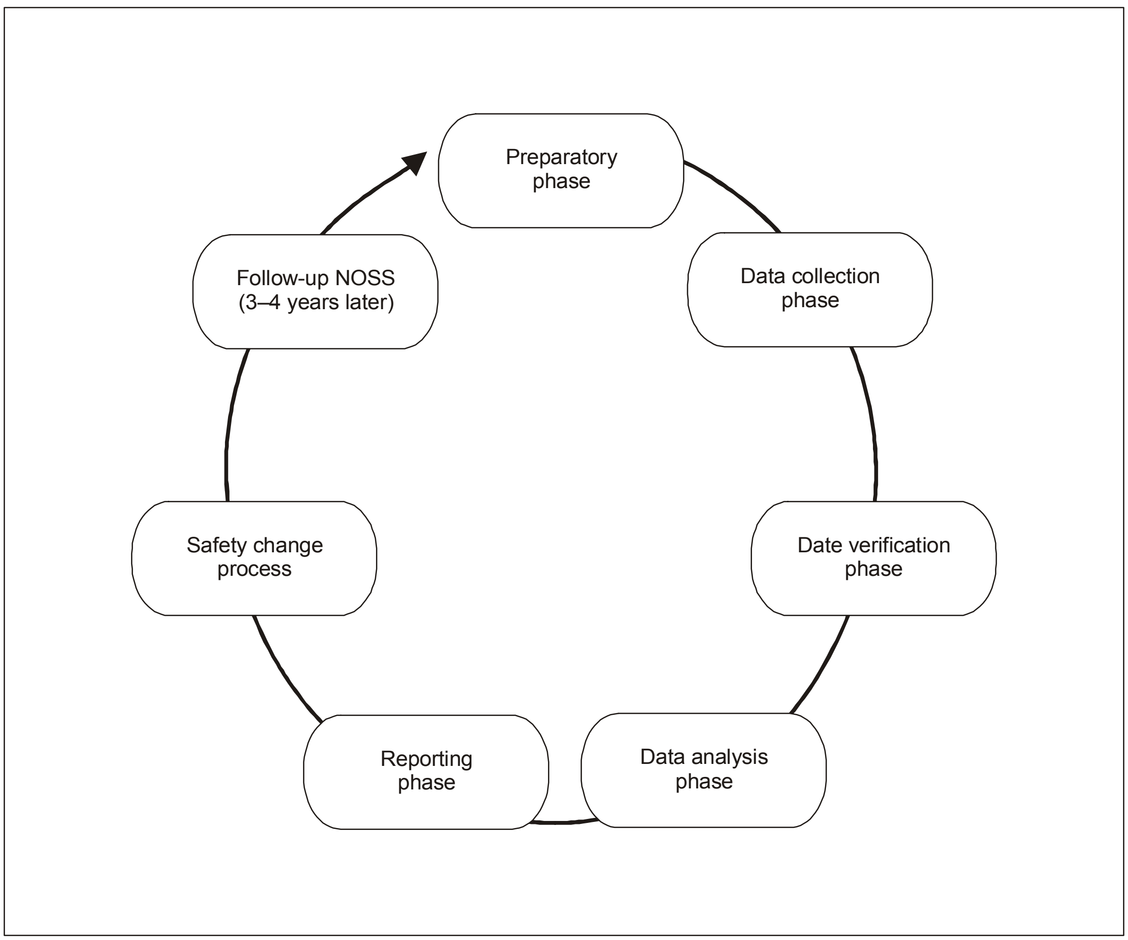

Figure 1-1. The NOSS cyclic process

b) ensures that remedial action necessary to maintain an acceptable level of safety is implemented;

c) provides for continuous monitoring and regular assessment of the safety level achieved; and

d) aims to make continuous improvement to the overall level of safety.

1.3.2 The safety management systems implemented by air traffic services providers generally comprise sources for the collection of safety data, such as voluntary and/or mandatory reporting systems, incident investigation programmes, and electronic data extraction systems.

1.3.3 What those elements have in common is that they are occurrence-driven, i.e. something abnormal in the operations of the organization has to happen for the system to notice it. Some event must trigger the data collection process. Accidents and incidents can be investigated only after they occur, and the events that are reported in voluntary and/or mandatory programmes similarly relate to occurrences that are not considered normal in daily operations. Even electronic data extraction systems are programmed to indicate deviations from pre-defined parameters that mark the boundaries of normal operations.

1.3.4 NOSS is designed to complement existing safety data collection sources. Its added value is that it provides data from normal operations (as opposed to abnormal occurrences in the operations), and it is not occurrence-driven like most of the existing mechanisms. NOSS can be scheduled at any time that is suitable for the organization, to sample the systemic safety performance in daily operations and to provide an overview of the organizational strengths and weaknesses in the management of threats, errors and undesired states during normal operations. The organization can subsequently act on the outcome of a NOSS before safety issues manifest themselves through occurrences.

1.3.5 As such NOSS is a tool that assists air traffic services providers to comply with Annex 11, 2.2.7.3 c), i.e. to “provide for continuous monitoring and regular assessment of the safety level achieved”.

1.4 NOSS OPERATING CHARACTERISTICS

1.4.1 To distinguish NOSS from other methods intended to collect safety data from normal operations, the following ten operating characteristics are unique to NOSS:

a) over-the-shoulder observations, with clearly defined stop rules, during normal shifts;

b) joint management/controller association support;

c) voluntary participation;

d) de-identified, confidential and non-disciplinary data collection;

e) systematic observation instrument based on the Threat and Error Management (TEM) framework;

f) trained and standardized observers;

g) trusted data collection sites;

h) data verification process;

i) data-derived targets for safety enhancement; and

j) feedback of results to the controllers.

1.4.2 Only a data collection method for monitoring safety in normal ATC operations that meets all ten characteristics mentioned above can use the name NOSS. Alternative methods may be developed that operate under different characteristics, but by definition these cannot be named NOSS. NOSS is designed to be a high-integrity operational tool and the ten characteristics are fundamental to preserving that integrity.

1.4.3 The ten NOSS operating characteristics are explained below.

Over-the-shoulder observations, with clearly defined stop rules, during normal shifts

1.4.4 NOSS observations are performed by an observer situated close to or behind the controller working the operational position where the observation is taking place (direct observation). (This set-up is similar to on-the-job training (OJT) in ATC, where the instructor sits close to or behind a trainee.) The NOSS observer will make short personal notes on a small notepad about certain operational situations, which will enable the observer to later reconstruct the situation when writing a narrative about the observation.

1.4.5 One of the attributes that distinguishes NOSS from other safety data collection mechanisms is that NOSS captures data from normal operations only, i.e. the successful daily operations for which no safety occurrence reports are generated. This implies that if, during a NOSS observation, a safety occurrence takes place, that particular observation will be terminated and the data will not be included in the NOSS report.

1.4.6 From a systems safety perspective, it is important to realize that in such an event the safety data are not lost to the organization, but are captured by the other mechanisms the organization has in place. For the NOSS project, however, that particular observation session is by definition no longer being conducted in normal operations, and consequently the data from that session will not be used for the NOSS report.

1.4.7 The point in the operations of an organization where normal operations are interrupted by a reportable occurrence or, in other words, the point where a NOSS observation session has to be terminated, is referred to as the "stop rule" for the NOSS observations. Stop rules will differ from one ATSP to the next, depending on the existing safety data collection mechanisms in the organization and indeed in the State concerned. The stop rule for use in a NOSS project will be discussed and defined during the training of the observers.

1.4.8 NOSS observations are conducted only at operational positions where no OJT instruction or checks are taking place. The reason for this is that NOSS is designed to provide an organization with a profile of its systemic strengths and weaknesses in managing threats, errors and undesired states during normal operations. Whilst an organization may spend a considerable amount of time training people to become qualified air traffic controllers, the organizational expectation should be that normal operations are provided by fully qualified controllers. It is thus only fair to consider the systemic performance from that perspective.

Note 1.— There is no reason that an organization cannot monitor safety in daily operations while observations are taking place or during checks and/or OJT sessions. For a NOSS, however, checks and OJT situations are to be excluded.

Note 2.— Observer training is discussed in Chapter 3.

Joint management/controller association support

1.4.9 Allowing observers to sit in during normal operations is not something that is easily accepted by aviation professionals. If the purpose of the observer's presence however is adequately explained to them, most aviation professionals will accept the presence of an observer whilst they are working. A proven way to communicate the purpose of NOSS observations, and indeed of the overall NOSS project in an organization, is to seek support for the project from both the management of the air traffic services provider (ATSP) and the controllers' association for the unit or area concerned.

1.4.10 When the management of the ATSP and the controllers' association are both seen to be supporting the NOSS project, the potential for acceptance by the controller workforce is greatly enhanced. One way to make the bilateral support visible is through a letter, signed by the highest appropriate executive in the ATSP and the president or chairman of the controller's association, which outlines the purpose and provides an overview of the NOSS project.

1.4.11 ATSPs considering conducting a NOSS must realize that the support of the controllers' association is crucial to the success of the NOSS. If, during the preparatory stages for a NOSS, a change were to occur in the leadership of the association or in the management of the ATSP, it would be advisable to reaffirm that support through a new joint letter.

Note 1.— A sample letter of support is provided in Appendix C.

Note 2.— Communicating the purpose of a NOSS project in an organization is discussed in Chapter 2.

Voluntary participation

1.4.12 Participating in a NOSS observation, be it as an observer or as an observed controller, shall be strictly on a voluntary basis. If a person is a suitable candidate to become a NOSS observer, that person shall have the option to accept or decline that responsibility. Similarly, controllers shall have the option to allow or refuse a NOSS observer to be present during their shift. Refusal of a candidate to observe or of a controller to participate in a NOSS observation shall be non-jeopardy for those individuals. No record of the person's identity shall be made; the only thing that the NOSS observer may communicate to the project manager is the reason (if known) why the person declined to participate.

Note 1.— The NOSS trials conducted in 2005-2007 suggest that normally the number of controllers who refuse to have a NOSS observer present can be expected to be low. There were a few cases where controllers declined the presence of an observer because they had already been observed once or twice before in the same NOSS period. Other than that, the preparedness of controllers to be observed for NOSS purposes was universally high.

Note 2.— Observer selection is discussed in Chapter 2.

De-identified, confidential and non-disciplinary data collection

1.4.13 The identity of the controllers who are on duty during a NOSS observation is not recorded. The only information recorded is the position where the observation takes place and the time when the observation starts and ends. The date on which the observation takes place is not recorded. The identity of the observer is not registered on the observation form with the narrative that is submitted by the observer.

1.4.14 All data from NOSS observations shall be considered confidential by the organization. Data collected during a NOSS programme shall not be used for disciplinary purposes under any circumstances. Any breach of confidentiality or trust can mean the end of using NOSS in an organization.

Note.— Data collection is discussed in Chapter 3.

Systematic observation instrument based on the Threat and Error Management (TEM) framework

1.4.15 The target for NOSS is the operational context in which air traffic controllers do their work. NOSS is designed to allow an observer to see the threats, errors and undesired states that are dealt with during normal operations in an organization through the eyes of the controllers. The observers are trained to recognize threats, errors and undesired states and how they are linked. The observers take minimal notes during the observations and fill out pre-designed observation reporting forms after the observation has been completed. These forms are structured to help elicit the threats, errors and undesired states from the narratives provided by the observers and also aim to capture how the identified threats, errors and undesired states were managed and what countermeasures were used by the controllers.

1.4.16 It is not expected that the observers will capture 100 per cent of all threats and errors made during the observation period. Emphasis is on the thoroughness of the data that is captured, even though some threats and errors are not captured.

Note.— Examples of NOSS observation reporting forms are provided in Chapter 3.

Trained and standardized observers

1.4.17 NOSS observers receive training in which the application of the Threat and Error Management (TEM) framework to ATC operations is explained. They are furthermore trained in using the NOSS observation forms and applying the appropriate codes from the NOSS coding tables. The training includes guidelines for the conduct of NOSS observations in the specific workplaces that will be observed, as well as guidelines on how to act if a safety occurrence happens during an observation ("stop rule").

Note.— For the purpose of this manual it is assumed that most ATS provider organizations considering the conduct of a NOSS do not have all the required expertise available in-house and therefore will require the services of an external NOSS facilitator to deliver the observer training, advise the project manager and generally support the NOSS project in the organization. Specific tasks are outlined in this manual for the project manager and the NOSS facilitator but these tasks may be executed by one person.

1.4.18 After the classroom part of the training, the candidate observers must perform at least two practice observations and fill out the associated reporting forms. The training facilitator will provide feedback to individual observers on the reports they have submitted. This one-on-one interaction between the facilitator and the observers helps ensure that all observers have the same view of what is expected of them (standardization) before they perform an actual NOSS observation.

Note.— Observer training is discussed in Chapter 3.

Trusted data collection sites

1.4.19 Even though the data collected in a NOSS are de-identified and confidential, they still possess a certain degree of sensitivity for the organization concerned, and it is therefore of great importance that a trusted site to store the data be selected and assigned.

1.4.20 The premise is that the data from NOSS belongs to the organization (ATSP) where the NOSS is conducted. It is therefore the responsibility of the organization to determine where the data will be stored.

1.4.21 The data from most of the airlines that performed a line operations safety audit (LOSA, a similar method as NOSS for use in the flight deck environment) is kept by a body called The LOSA Collaborative (TLC) that was specifically created for that purpose. The airlines concerned agreed that their LOSA data are to be kept there for security purposes. For NOSS, a similar body has been created but detailed information on that body was not available at the time this manual was produced.

1.4.22 Factors that can help determine whether or not an ATSP should store NOSS data in-house comprise *inter alia*: the national legislation on freedom of information (i.e. to the press and the public), the status of the air traffic services provider (e.g. part of the government or corporatized) and, last but not least, the need to be able to benchmark or otherwise compare the data with other organizations where a NOSS was performed.

1.4.23 Alternative locations for storing NOSS data could include, but are not limited to, universities or aviation research laboratories in the State or region of the ATSP.

Note.— Data storage is discussed in Chapter 2.

Data verification process

1.4.24 After the NOSS data collection period, a "data verification round table" is held. This is a data verification process, which typically involves four or five key persons from the NOSS project in an organization and may last up to five days, depending on the amount of data that has to be processed. The purpose of the data verification process is to ensure that all data from the observations are coded correctly and consistently before they are analysed. To that end the participants in the data verification process review all observation reports to verify the threats, errors and undesired states that the observers have entered and coded. In the verification process extensive use is made of the applicable ATC procedures for the unit(s) observed in the NOSS.

Note.— Data verification is discussed in Chapter 4.

Data-derived targets for safety enhancement

1.4.25 The final report that is produced as the result of a NOSS presents an analysis and interpretation of the data collected during the organization's normal operations. The report must contain clear indications for the SMS of the organization of where the systemic strengths and weaknesses are vis-à-vis the management of threats, errors and undesired states in the operational environment. The report assists the SMS to determine the effectiveness of the organization's existing safety strategies and countermeasures and, at the same time, enables the SMS to identify specific areas where safety improvements can be made.

Note.— The NOSS report is discussed in Chapter 5.

Feedback of results to the controllers

1.4.26 After the NOSS report has been made available to the organization, the results of the NOSS should be communicated to the controllers in the organization, including the controllers of the unit(s) where the observations were performed as well as other units, when feasible. Items the controllers typically will be interested in include the findings of the report and the action that the organization proposes to take as a result of it.

Note.— Using the NOSS results in the organization is discussed in Chapter 6.

1.5 RESOURCES REQUIRED FOR CONDUCTING A NOSS

1.5.1 When an organization is considering conducting a NOSS, the question of what resources are required will inevitably be asked. Based on experience gained from the trials that were held in 2005 and 2006, the following items must be considered:

a) travel expenses (including allowances where applicable) for the project manager and observers;

b) accommodation for the project manager and observers (if observations take place at locations other than the normal workplace);

c) the cost of a NOSS facilitator (optional; from within the organization or external);

d) observer training;

e) travel and accommodation expenses for participants in the data verification process;

f) the cost of a data analyst and report writer (from within the organization or external);

g) labour costs for the project manager and observers (from within the organization).

1.5.2 Alternatively, broken down according to function, the list is as follows:

a) Project manager — labour costs to prepare and run a NOSS, including post-observation activities (e.g. data verification, report delivery and project follow-up); travel and accommodation (including allowances) for staff and management briefings and during the data collection phase.

b) NOSS facilitator (optional) — labour costs (if from within the organization); labour costs, travel and accommodation (if external to the organization) for the agreed period(s) over which the facilitator will assist the organization in preparing for the NOSS.

c) Observers — labour costs; travel and accommodation (including allowances where applicable) during training and observations.

d) Procedures specialist (if applicable) — labour costs, travel and accommodation (including allowances) during data verification.

e) Data analyst/report writer — labour costs (if from within the organization); fees, travel and accommodation (if external to the organization).

f) Safety specialist (if applicable) — labour costs to process and evaluate the report.

1.5.3 Since NOSS is not a continuous programme but rather a periodically recurring one, organizations will find that the resources required for a NOSS are modest in comparison to other safety programmes. The exact amount will depend on the periodicity of subsequent NOSSs, as well as on their scope. For example, the cost of a NOSS conducted once every five years in the busiest sectors of the main ATC facility only will differ from that of a NOSS conducted every three years at all working positions in every ATC facility of the organization.

1.6 BENEFITS OF NOSS

1.6.1 The benefits of NOSS include (in no particular order):

a) *Proactive hazard identification.* One of the key benefits of NOSS is risk management, specifically the proactive identification of hazards and risks. NOSS is a data collection tool used during normal operations and therefore there is no triggering event to initiate the NOSS process. Thus the organization can learn about hazards, risks and their potential precursors before an incident or accident occurs.

b) *Prioritized safety actions.* The NOSS report findings provide risk management information, and senior management can use the findings to help prioritize safety management activities. It helps the organization answer the question “Where do we need to focus our efforts?”

c) *Enhanced understanding of air safety incident trends.* NOSS data provide a larger context in which the events occur as well as an understanding of the defensive measures that are employed to make the majority of similar events inconsequential. With NOSS data available the organization is better placed to predict high-risk activities before they lead to incidents.

d) *Converging lines of evidence.* Because NOSS is different from other safety data collection tools (e.g. unit evaluations, investigations, safety reviews), it provides an excellent opportunity to identify "converging lines of evidence" — if similar issues are identified using different methodologies, it provides a higher level of confidence for assessing the risk level.

e) *Identification of areas of strength.* NOSS identifies areas where threats are being well managed, thereby allowing the organization to know what is working well.

f) *Improved organizational trust.* The principles of joint management/controller association support, voluntary participation of the controllers being observed and a trusted data collection site contribute significantly to the trust in the NOSS process as an SMS activity in the organization.

g) *Engaged workforce.* NOSS fosters a positive safety culture through an engaged workforce. The ten NOSS operating characteristics (including voluntary participation, peers observing peers, the involvement of controllers in data collection and data verification, and providing feedback to controllers) lead to this strong engagement of the workforce, which continues through management's safety change processes, where controllers can be involved in the mitigation of the identified issues.

h) *Positive cooperation with the regulator.* Implementing NOSS requires cooperation with the regulator to ensure that the integrity of the NOSS process is maintained. The example below dealing with reportable occurrences during a NOSS in Canada illustrates this point.

In Canada, the definition of a mandatory "reportable occurrence" is rather broad; therefore, it is possible that a NOSS observer might witness a reportable occurrence that the controller being observed does not notice. Given that the observer is supposed to act as a "fly on the wall", the question to the regulator was "can the observer be excused from the regulatory requirement to report the event"? The answer was "yes" with the motivation that the regulator "considers the NOSS initiative as a positive move that has potential to contribute to an increase in the integrity and safety in the provision of air traffic controller services".

i) *Exchange of information, industry benchmarking and collaboration with airlines.* The Threat and Error Management framework allows for the potential exchange of safety issues with airlines who are applying LOSA, and with other air traffic service providers who are applying NOSS. Through such exchanges, it will be possible to identify and address issues at the industry level.

j) *Decision support tool.* The data derived from a NOSS provide valid, fact-based evidence to support or challenge decisions that were previously based only on expert opinion. Team leaders, supervisors and unit managers are usually aware of the characteristics of their sectors, through a number of relatively informal sources, and of the challenges some of these characteristics present to their controllers. Using the data derived from NOSS enables management to initiate change based on factual information and not merely expert opinion.

k) *Verification of the quality and usability of procedures.* A NOSS provides feedback on procedures. For example, if 5 per cent of observed controllers do not follow a particular procedure, there may be a problem with those particular controllers. If, however, 50 per cent of controllers do not follow a particular procedure, the problem most likely resides with the procedure. The procedure may be poorly understood or timed, or may be a poor fit for the operating environment. Poor adherence rates can identify problematic procedures or procedural drift.

l) *An understanding of controller shortcuts and workarounds.* As a result of experience, controllers develop shortcuts and workarounds to save time and work more efficiently. These shortcuts may involve contraventions of procedures and are seldom seen during checks/audits where performance is typically strictly according to the rules. Through a trusted process such as NOSS, it is possible to observe such shortcuts and workarounds, some of which may be deemed effective and can be communicated to others within the organization as a "best practice". Similarly, shortcuts and workarounds that have shortcomings in their safety assumptions can also be identified and addressed.

Chapter 2

PREPARING FOR A NOSS

2.1 ASSOCIATION AND MANAGEMENT ENDORSEMENT

2.1.1 In preparation for a NOSS, support for the project from the association representing the controllers (which may be a union) and from ATSP management must be obtained at an early stage. Support from management may seem like an obvious requirement with respect to the logistics of a NOSS project, but in combination with the support from the controllers' association, it also serves a promotional purpose.

2.1.2 Where no association or union representing the controllers exists, an ATSP considering conducting a NOSS is still encouraged to seek support for the project from the controller workforce.

2.1.3 An effective way to illustrate the joint support is through a letter, signed by the highest appropriate manager of the organization (e.g. the chief executive officer) and by the chairperson or president of the controllers' association, endorsing the NOSS project. A generic template for such a letter is reproduced in Appendix C. Copies of this letter can be carried by the NOSS observers when going out to conduct their observations, as a reminder to staff that the project has been endorsed by both the organization and the association.

Note.— Trials have shown that the time span between the first preparations for a NOSS and the start of the data collection period covers at least 6 months.

2.2 PROJECT STEERING COMMITTEE

2.2.1 Consideration should be given to the establishment of a project steering committee to oversee the preparation, implementation and follow-up of a NOSS in the organization. The steering committee typically comprises the NOSS project manager, a representative from the controllers' association, a management representative and a representative from the operational environment (e.g. a supervisor). One of the tasks of the steering committee could be to plan and design the NOSS promotion campaign as part of the project management plan.

Note.— Organizations should avoid creating an overly large steering committee. Its major purpose is to ensure that the organization is well-prepared for the NOSS project.

2.2.2 The project steering committee is also the logical platform to address whether or not the organization needs the services of an external NOSS facilitator and/or a data analyst for the NOSS project. If it is the first time that a NOSS is being conducted in the organization, chances are that external services will be required. However for an ATSP that has prior experience conducting a NOSS, this expertise may already be available in the organization.

Note.— In the subsequent parts of this manual, specific tasks or duties are allocated to the project manager, the NOSS facilitator and the data analyst. In practice it may be that those tasks and duties can be undertaken by less than three individuals, depending on the circumstances in the ATSP where the NOSS is conducted.

2.3 ROLE OF THE NOSS PROJECT MANAGER

2.3.1 The NOSS project manager is the organization's "champion" of NOSS. The project manager is the person to elicit the support for the NOSS project from both ATSP management and the controllers' association as described in 2.1. The project manager organizes briefings for different levels of management as required, to assist in setting the organizational expectations for the NOSS project. The project manager organizes the resources for the NOSS project, promotes the project within the organization and in general acts as a troubleshooter for the duration of the project. In the data collection stage the project manager may also be responsible for rostering the observers.

2.3.2 Overall the responsibility for supporting the observers and maintaining their motivation throughout the data collection phase is that of the project manager. The project manager should act as a mentor and provide channels for open and honest two-way communications with the team. The project manager should be responsive to observer needs and act quickly to resolve any issues that may arise.

Note 1.— Where a NOSS facilitator is involved, the items assigned to the project manager may be shared between the two.

Note 2.— The attributes of the NOSS facilitator and the data analyst are provided in Appendix E.

2.4 PROMOTION CAMPAIGN

2.4.1 In the months leading up to the actual data collection period, a carefully orchestrated promotion campaign will assist in making the workforce understand the purpose and workings of a NOSS. From a project management perspective, a promotion campaign assists in conveying the notion that information about the NOSS project is transparent in the organization. The promotion campaign can comprise (but is not limited to) articles in company publications, articles in publications from the controllers' association, posters, information sessions and/or direct mailings to the staff.

2.4.2 One ATSP created a dedicated NOSS website within their company web domain where staff members could find all relevant information about the project. The names and contact details of the NOSS project manager and the project steering committee members were provided, and audio-visual presentations (that were used in on-site briefings for management and/or staff) could be viewed and downloaded. Articles about TEM, NOSS and LOSA from external magazines were also made available on the website.

2.5 NOSS TARGET SELECTION

2.5.1 For most ATSPs, conducting a NOSS in the entire operational environment will not be feasible. Then again, NOSS is not designed with that specific purpose in mind. NOSS is designed to capture data in a selected part of the operation over a limited period of time. Therefore an ATSP should determine early on in the project which specific part of the operation will be the target for the NOSS. This could be one particular (radar) sector or one specific aspect within the operations of a facility, such as "the morning inbound rush", or operations in one or more tower facilities.

2.5.2 A NOSS that covers a large array of operations may highlight more general issues, but by focusing on smaller units of analysis (e.g. conducting a NOSS within an ACC as opposed to across multiple ACCs), more detailed information about the operating environment will be captured. Results from earlier trials indicate that ATSPs that do not try to cast too wide a net can maximize the information derived from the NOSS that can be used during the safety change process.

2.5.3 After conducting a NOSS in a specific area of the operation an ATSP may decide to target a different area for another NOSS, thus potentially covering the entire operational environment over a number of years.

2.5.4 Closely associated with the target selection are issues such as the duration of the data collection period, the logistics involved and the timescale for the NOSS. The project steering committee may be the most suitable platform to deal with those issues.

2.6 SCOPE OF THE NOSS

2.6.1 Once the NOSS target has been selected, the next item to decide on is how many observations will be required in order to obtain a representative view of the normal operations in the target area. If too few observations are conducted, it will be difficult to be sure that the data collected are representative of operations. Important trends may be overlooked and, as a result, the information in the final report will be diluted. On the other hand, if too many observations are conducted, this can affect the motivation of the observers and the observed alike, and it will take longer for the NOSS report to be completed.

2.6.2 Because of differences between ATSPs (e.g. the number of controllers per sector and/or working position) and between operational units (e.g. size and layout of the operations room), it is not practical to specify in this manual the requisite number of observations for a NOSS. The numbers mentioned in the following paragraphs are meant as guidance only; the requisite number for a specific NOSS needs to be determined by the appropriate persons in the ATSP, e.g. the NOSS project steering committee.

2.6.3 In order to determine how many observations are appropriate, it is necessary to consider the scope of the NOSS. The number of working positions in the towers, approach and/or area sectors to be included in the NOSS should dictate the number of observations conducted. For example, if a NOSS is scheduled in a tower environment with one ground control position and two runway control (or air control) positions, a representative sample could be obtained by conducting 30 observations on the ground control position, and a total of another 30 observations on the two runway control positions. (Assuming that the two runway control positions are of equal complexity and workload, the observations can be divided 30-0, 15-15, or 0-30, just to give some examples, as long as the required total number is reached.) In a smaller tower with only one controller plus an assistant, a representative sample could probably be obtained by conducting 40 to 50 observations of the controller position.

2.6.4 If a NOSS is being conducted in an ACC with five groups of sectors, 25 to 30 observations would be conducted on each group, equally distributed amongst the sectors in that group.

2.6.5 It is to be expected that during the data collection period some observations will have to be terminated as a result of operational developments at the working position or, for other reasons, will not result in a usable observation report. Therefore the total number of scheduled observations should be 5 to 10 per cent higher than the minimum number of observations required to produce a valid NOSS project report.

2.7 DURATION OF THE NOSS

2.7.1 When considering the very first preparatory activities for a NOSS as the starting point, and the delivery of the final report as the end point, the duration of a NOSS may be anywhere between 6 and 9 months. This period however will most likely be experienced as such only at the NOSS project management level. For the operational staff in an organization, the starting point will probably be perceived to be the first day of the data collection phase. Therefore, to the operational staff, the duration of the NOSS project will appear to be in the order of 2 to 4 months, depending on the time required to analyse the data and prepare the report.

2.7.2 The duration of the data collection period is to a large extent determined by the number of observations that need to be scheduled. As a general guideline though it is recommended to collect the data in a period of one or two months, in order to provide flexibility in rostering observers, prevent observers from becoming fatigued, prevent the observed staff from tiring of the constant presence of observers, and capture data over a wider time frame, which will provide a more representative depiction of the operation. During this period the collection of data is not necessarily a continuous process, i.e. the NOSS observations do not have to take place every day in this period. If data were to be collected over a period longer than two months, however, there is a risk that organizational momentum and focus may be lost.

2.8 TIME FRAME FOR THE NOSS

Together with deciding on the target, scope and duration of a NOSS, consideration must also be given to where the project fits in with other ongoing activities and developments in the ATSP organization. If new equipment has been commissioned, or major changes in procedures are being implemented, that is probably not a good time to conduct a NOSS. On the other hand, if a period is foreseen in which there will be a relative surplus of staff available, this might be an excellent opportunity to schedule the data collection phase of a NOSS. No all-encompassing guidelines are available for deciding on the time frame, except that the NOSS project steering committee would seem to be the logical platform for this discussion.

2.9 LANGUAGE FOR THE NOSS

One of the NOSS trials was held in a State where English is not the first language. This did not present any problems since the level of conversational English within the observer group was high. However, it was suggested after the trial that perhaps the observer reports might have been of an even higher quality if they could have been written in the native language of the participants. Any ATSP can of course opt to conduct a NOSS in the local language, as long as it is realized that a decision to translate the NOSS supporting material may have implications for external support, coding and potentially also for benchmarking of the NOSS results with other ATSPs.

2.10 OBSERVER SELECTION

2.10.1 During the data collection period, which to the operational staff in an ATSP is the most visible part of a NOSS, the role of the observers is more than just that of collecting the data. Because of their proximity to the staff at the operational positions, the observers also become the “face of NOSS” in that period. Even though observers are expected not to interact with the controllers they observe, it is inevitable that some questions will be asked by the operational staff before the observation is conducted, or immediately after.

2.10.2 Those interchanges are usually about the purpose of the observations, or the NOSS methodology in general, and may contribute significantly to the understanding and acceptance of the observation process by the workforce. It is therefore prudent to keep that aspect in mind when selecting the candidate observers for a NOSS.

2.10.3 Attributes of suitable candidates to be selected as NOSS observers include:

a) *Professional credibility and trust.* The person should be accepted by his/her peers as a good controller and a trustworthy individual. This acceptance does not necessarily have to be reflected in the person's experience, seniority or ATC qualifications (e.g. instructor, examiner, checker). In fact in the trials some of the best observation reports were produced by controllers who were quite junior in their organization and/or career.

b) *Analytical quality.* The person must be able to look at the context of operational work with an analytical mind, without getting too immersed in the technical details of the work observed.

c) *Open-mindedness.* The person must have the ability to recognize that methods and techniques that differ from the ones he/she uses can be equally effective to get the job done.

d) *Motivation.* The person should have an intrinsic interest in aviation safety processes and be able to pass on that interest to others in his/her working environment.

e) *Sound judgement.* As an observer the person will have rather far-ranging discretion on what to include in the reports and also, for example, when to terminate an observation.

Note.— In case the observation reports are to be submitted electronically by the observers, it is recommended that "basic computer skills" be included in the list of observer selection criteria.

2.10.4 The number of observations that each observer typically is expected to conduct is between 10 and 15, depending on the scope of the NOSS. Previous NOSS trials have indicated that the workload for the observers is perceived to be high, so care must be taken to not overload the observers in the data collection period. One possible way to prevent observer overload is to have them work regular shifts for a few days between consecutive observations.

2.10.5 In order to ensure a wide diversity of observer backgrounds, it is recommended that candidates be selected from a multitude of operational working places in the organization (e.g. different sectors and/or aerodromes) and have differing levels of experience and qualifications.

2.10.6 As a general rule, the majority of observers should be currently rated and qualified controllers from the organization where the NOSS is held. An advantage of using peer controllers is that the perception in the organization of the validity of the data will be enhanced. This group may be augmented with observers from other groups (e.g. recently retired controllers, simulator instructors, checkers), preferably all from the ATSP concerned but optionally also from other sources. External participants could, for example, be included in order for them to get first-hand experience with the NOSS process, e.g. in case they are from an ATSP that is also considering conducting a NOSS. It is recommended however that the number of external observers be limited.

2.10.7 Observers who are not rated at the working position they observe usually produce better reports than observers who are rated at that position. An explanation for this may be that rated observers tend to become absorbed in the technical details at the working position more than non-rated observers do. Non-rated observers in contrast tend to focus more on the situation as a whole at the working position, which in essence is what a NOSS is looking for.

2.10.8 Since the joint support of management and the controllers' association is one of the NOSS characteristics, one elegant and simple way to demonstrate this is to have the management and the association each draft a list of candidates that they think are suitable to serve as NOSS observers. By selecting from the names that appear on both lists, the NOSS project manager will ensure that the team of observers is fully acceptable to the parties involved.

2.10.9 An alternative method, which was used by one of the ATSPs involved in the NOSS trials, is to submit the name of the interested candidates from the appropriate groups to both the management of the ATSP and the controllers' association for approval. By using only candidates whose names have been approved by both parties, the acceptance of the team of observers will be equally ensured.

2.11 OBSERVATION PROTOCOLS

2.11.1 The NOSS project manager, together with the steering committee, must give consideration to the creation of an observation protocol that lays down clear rules and agreements that govern the practical issues of the observations that will be conducted.

2.11.2 Topics that should be addressed in the observation protocol include, but are not limited to, the following:

a) How will observers act when entering the operations room? (e.g. Do they proceed directly to the position where the observation will be done or do they formally report to the supervisor?)

b) Can a supervisor object to an observation taking place in the operations room?

c) How should observers act when an observation is refused (either by a controller or by a supervisor)?

d) How should observers act when, during an observation, a controller starts a discussion with the observer?

e) How should observers act when during an observation a controller is relieved from the working position by another controller with a trainee (or a checker)?

f) How should observers act when during observations they see an unsafe situation developing that is apparently not adequately being attended to?

g) How should observers respond when at the end of an observation the controller or supervisor wants to know "how they did"?

2.11.3 Because of existing differences between organizations and facilities, it is not possible to provide a list of uniform answers to the questions above. However there are generic guidelines that must be kept in mind when formulating the answers for a specific NOSS:

a) The observers must be as unobtrusive as possible during observations.

b) The observers are not there to assess the performance of individual controllers.

c) The observers should not interfere with the ongoing operations unless safety clearly is about to be compromised. (This situation may be compared to an on-the-job-training situation, where the instructor has to decide to what stage a situation can develop before an intervention is necessary.) An observer should not permit a traffic situation to degrade to the point where safety is compromised. The observer should give the controller(s) a reasonable opportunity to manage and resolve the situation. If it appears however that the situation will not be resolved in time, the observer is expected to bring the situation to the attention of the controller. This action will show that NOSS observers will not let safety be jeopardized and that they will provide an additional defence for the controller while present.

d) If an incident should occur during a NOSS observation, conventional incident reporting mechanisms are expected to prevail. The observation will cease and the data will not be used for NOSS purposes.

e) If a controller declines to be observed, the observer should simply withdraw. The observer should inform the project manager at the earliest convenience about this and, if known, provide any rationale as to why the controller may have refused. While it is not necessary for the project manager to know the identity of the controller who has refused, it is important that the project manager determine if this was merely an isolated event or if the refusal was due to a bigger issue such as a lack of understanding of the goals of NOSS or a miscommunication. With this knowledge, the project manager will be able to decide on remedial actions when appropriate.

Note.— Observers should feel free to discuss observation details (including problems) with the project manager and/or facilitator; however, they shall refrain from discussing such information with anyone else.

2.12 DATA STORAGE AND PROTECTION

2.12.1 Another aspect that should be addressed in the preparatory stages of a NOSS is where the data from the observations will be stored after collection and analysis. Despite the fact that by definition all collected safety data are from normal operations (i.e. in which no incidents or accidents occurred), the data must be considered sensitive by the organization where the NOSS is done as well as by any external parties that may be involved in the analysis of that data. NOSS findings, and especially the raw data, are best understood by having a firm understanding of the underlying theoretical foundation established by the TEM framework to ensure effective insights and consensus on safety trends and avoid potential misinterpretation. For the integrity of the NOSS process, it is essential that the data be protected from inappropriate use.

2.12.2 Nevertheless it should be clear to external parties that the ATSP is not trying to avoid addressing data-derived safety concerns but that the organization does this only to protect the involved parties. One possible solution is for ATSPs to provide specific briefings to regulators and/or industry stakeholders to show the benefits of NOSS and what will be accomplished as a result of the NOSS report. Such action will show the willingness of the ATSP to act upon identified concerns without compromising the integrity of the NOSS process.

2.12.3 In some States it may be possible for the ATSP to store the data in-house without any difficulties, but in other States this may not be feasible. Solutions that may be worth investigating in this respect include the creation of an independent body (nationally or regionally) for the storage of the data, or storing the data in an institution that is not legally bound to make information available to the public (e.g. a university or a research laboratory).

Note.— Benchmarking of the data (i.e. comparing results of the analysis with those of other ATSPs) may be more difficult if the choice is made to store the data in-house or if different frameworks are used.

2.13 PREPARING TO RECEIVE AND ACT UPON THE NOSS REPORT

2.13.1 The NOSS report is a diagnostic document that will provide the organization with valuable data that describe a true and accurate picture of the daily operating environment. It is important that the organization has a mature view of its operation prior to embarking on a NOSS, which will, of course, highlight areas of both strength and weakness. While areas of strength are easy for the organization to accept, areas of unexpected weakness can potentially cause an overreaction if not properly managed. To ensure the outcomes of NOSS are balanced, all data must be kept in perspective especially if some findings challenge existing organizational beliefs.

2.13.2 Planning for the report's arrival is essential if the follow-on benefits facilitated by NOSS are to be fully realized. The NOSS report is merely a diagnostic overview of what is occurring during normal operations and does not indicate solutions. For meaningful safety change to occur, the organization must determine why particular patterns of threats, errors and undesired states are occurring. Addressing the conditions that lead to the observed patterns is what will lead to meaningful safety change. It is important to discourage “knee-jerk” reactions to the findings that will not bring about lasting change and may damage acceptance of the NOSS process amongst front-line staff.

2.13.3 To ensure that the maximum benefit is gained from a NOSS report, the organization must prepare well in advance. In reality this preparation should start before the decision to commit to a NOSS is made. At that stage the following points should be considered with the final report in mind:

a) What does the organization hope to achieve from NOSS? The organization must be clear about the outcome that is sought and be confident that their expectations are realistic.

b) Is senior management prepared for unexpected and possibly undesired findings?

c) Do any groups within the organization have strong negative agendas that could be boosted by the NOSS findings? The NOSS findings should always be seen as enlightening to all levels of the organization and never as a political tool.

d) Is the organization prepared to share all findings, good and bad, with staff?

e) Is the organization committed to addressing issues highlighted by the NOSS?

2.13.4 If any of the above questions cannot be fully answered then the decision to proceed with the NOSS should be reconsidered. If the organization is not properly prepared for potential NOSS findings, the report may be relegated to a drawer somewhere without leading to any safety improvements in the organization, thus negating the effort of conducting the NOSS.

2.14 BRIEFINGS OF AFFECTED GROUPS

2.14.1 Briefings provide both an ideal opportunity to explain the NOSS concept and a forum to identify unforeseen issues and answer questions. Each briefing should be carefully planned to ensure a logical flow of information that focuses on the needs and requirements of each particular group. At each briefing ample time should be allowed for questions and discussion on key issues.

2.14.2 The content of each briefing needs to be tailored to each group's needs; however, there are a number of generic items that should be included in all briefings:

a) the purpose of the NOSS and the intended outcomes;

b) where the NOSS process fits into the organization's safety management system (SMS);

c) the extent of the planned NOSS including the locations to be observed and the timeframe for the NOSS;

d) an explanation of the NOSS operating characteristics; and

e) the name and contact details of the project manager for any queries or issues that may arise in relation to the planned NOSS.

2.14.3 To ensure a smooth build-up to the start of the NOSS, a schedule of required briefings should be formulated. This schedule should provide a logical progression, with the first briefings being held for those groups whose support is critical for the planned NOSS to go ahead. Groups that would fall into this first category, and the general content of the briefings, would include but not be limited to the following:

a) Senior management
Key issues:
— Benefits to the business
— Resource requirements
— Benefits to the SMS
— Projection of costs
— Risks to the business
— Overview of the project plan
— Security of data

b) Staff representatives/union groups
Key issues:
— Security and ownership of data
— Data de-identification and management procedures
— Observation protocol, including “stop rules”
— Refusal procedures
— Format of final data presentation
— Observer selection protocols.

2.14.4 Subsequent briefings would be more focused on the practical elements of running the NOSS. Groups that would fall into this category, and the general content of the briefings, would include but not be limited to the following:

a) Operational managers
Key issues:
— How each observation will be scheduled
— Disruptions to normal operations (e.g. maintenance)
— Staff interaction with observers
— Integration of observations with training/checks, etc,

b) Supervisors
Key issues:
— Supervisor involvement with observation selection
— Supervisor interaction with staff during observations
— Disruptions to normal operations/interactions with observers
— Integration of observations with training/check shifts, etc.

c) General staff
Key issues:
— A more detailed explanation of the NOSS operating characteristics
— Expected numbers of observations on each sector
— Procedures for recording activities occurring at adjacent operating positions
— Data de-identification and management procedures
— Security and ownership of data
— Observation stop protocols
— Format of final data presentation
— Observer selection protocols.

2.14.5 It must be remembered that NOSS is a process that captures and describes threats, errors and undesired states in the daily operational environment, including the strengths and weaknesses in how they are managed, in an open and frank manner. Correctly managed briefings that promote this philosophy will greatly improve the likelihood of a successful NOSS. Preparation and planning are the keys to success in this area and if correctly executed will result in an informed organization that is prepared and willing to participate.

Chapter 3

OBSERVER TRAINING AND DATA COLLECTION

3.1 OBSERVER TRAINING OVERVIEW

3.1.1 Observer training usually takes no more than five consecutive days and is done in a group. The training is typically provided by the NOSS facilitator and/or the project manager. The first two days are spent in a classroom environment; test observations (including report writing) are done on day three and day four; and on day five the facilitator provides feedback to individual observers about the content of the reports they have provided. After this feedback the observers normally are ready to conduct their actual observations. During the first "solo" observations the facilitator may continue to provide feedback to observers as and when required.

Note 1.— If the quality of these first observations is deemed satisfactory, the observation reports can be included in the total for analysis.

Note 2.— Consideration may be given to conducting a group feedback session for all observers after the first observations.

3.1.2 The classroom training typically comprises (but is not limited to) the following:

a) an overview of the NOSS methodology;

b) an explanation of where NOSS fits in the safety management activities of the organization;

c) a detailed explanation of the TEM framework;

d) case studies to improve the understanding of the components of the TEM framework;

e) an explanation of the observation reporting forms including the code books for threats, errors and undesired states;

f) examples of "good" and "poor" narratives in the reporting forms;

g) an explanation of the observation protocol, including "stop rules";

h) assignment of the locations and/or positions that will be observed to individual observers;

i) communication arrangements with the facilitator and/or the project manager during the observation period;

j) logistical details for observer travel and accommodation (if applicable).

Note 1.— All of the points above are addressed in this manual.

Note 2.— It is strongly recommended to have the data analyst (if applicable) attend at least the classroom part of the observer training. By doing so the analyst will acquire a good understanding of the nature of the data that is to be processed.

3.2 BACKGROUND KNOWLEDGE AND OBSERVER TRAINING

3.2.1 Observer training comprises the following two elements.

a) background knowledge; and

b) practical observation skills.

Background knowledge

3.2.2 This element concentrates on the knowledge of Threat and Error Management (TEM) required to conduct fruitful NOSS observations and provides instruction on how to use the observation tool to produce observation reports. Each element should be covered repeatedly to ensure a full understanding of the NOSS process and objectives. Without a solid theoretical knowledge of the TEM principles and NOSS processes, observers will struggle during the observation phase, which in turn will significantly affect confidence and motivation and, consequently, data quality.

Practical observation skills

3.2.3 This element provides training in the practical skills required to conduct useful observations. The skill training to support the observers should include, but not be limited to, the following:

a) how to request an observation and how to deal with refusals;

b) how to appear unobtrusive;

c) how to take notes;

d) how to answer questions;

e) stop rules;

f) observation duration;

g) time management to complete observations and associated write-ups.

Note.— If the observers are expected to submit observation reports by electronic means this topic should be included in the training.

3.2.5 This skill element of the training should have a strong emphasis on building observer confidence and provide a realistic picture of the effort and commitment that will be required to complete a series of observations. Observer motivation is a key factor in the success of a NOSS, and the mental preparedness of the observers is an essential part of their preparation. Without adequate training in this area, observers may quickly become disillusioned and disheartened which will be reflected in the quality of their observation reports. It is also important that observers understand that their first few observations are likely to require some adjustment in style and content and that this is quite normal and expected.

3.2.6 Even with the best possible training, it is normal for observers to feel somewhat apprehensive before their first observations. To assist the observers through this period, support staff should be readily available to answer their questions and address unforeseen problems that arise. In general the project manager and/or NOSS facilitator should be able to provide this support. Experience from previous NOSS trials indicates that most observers are comfortable with the task by their third observation.

3.2.7 As mentioned before, NOSS trials have shown that the workload for the observers is perceived to be high. This aspect should be clearly stated in the observer training in order to help the observers mentally prepare for their task.

3.2.8 After the classroom training, the participants will be assigned an operational position where they will perform their first observation. Consideration should be given to having this first observation performed in the unit where the observer normally works, in order to give the observer a familiar environment in which to conduct an unfamiliar task for the first time.

3.2.9 The participants are expected to write a full observation report after their first session, just like they will later on in the NOSS. The report is sent (or given) to the facilitator, who will look at the structure and content of the report and provide initial feedback to the observer on those and other points.

3.2.10 The initial feedback from the facilitator can be applied by the participants when they conduct a second observation, for which they will again provide a full report. The facilitator will provide individual feedback as appropriate to all participants on the last day of the course. The participants will then also have the option to discuss any issues that arose during their test observations, e.g. questions and comments from observed controllers, logistical problems.

3.2.11 The detailed individual (or group) feedback marks the end of the formal training, and the observers should then be ready to begin their observation work. As reports are received from the observers, the facilitator and/or project manager may still provide additional feedback to individual observers about the content and structure of the reports as and when required.

3.3 GENERAL GUIDELINES

3.3.1 NOSS aims to capture safety data during normal ATC operations through the use of observers. In order to ensure that ATC operations during such observations be as close to "normal" as possible, it is essential that the observers be as unobtrusive as they can be when in the operations room or tower. This means that observers should avoid discussions with the staff on duty (to the extent of not being perceived as unsociable or impolite) and should not comment on what they see. They should also not take extensive notes or fill out any type of forms during the observations. All of these and similar activities will make a particular session less normal than if the observer were not present and are therefore not desired.

3.3.2 Observers should introduce themselves to the staff on duty at the position where the observation is to be performed and briefly explain their presence. Subsequently the observer should be seated at a spot where the activities at and around the work position that is to be observed can easily be followed without hindering the controllers at that position.

3.3.3 It is unavoidable that at times controllers will attempt to engage the observer in conversation for various reasons, often to ask questions about NOSS. Observers should be encouraged in training to minimize conversation by telling the controller that they would be happy to discuss things once the observation has been completed, or by physically withdrawing (e.g. pushing their chair back from the operating position).

3.3.4 Observers can use a sheet of paper, or a small notepad, to make short notes to consult later when writing the observation report. These notes should assist in reconstructing the events that were observed, once the observer is in an office or hotel room where the report is written.

3.3.5 It is not recommended, and is even discouraged, to let observers carry a clipboard with pre-designed forms to fill out during their observations in an operations room or tower. Such behaviour would likely distract the ATC crew from their work and thus interfere with the objective of monitoring a normal operation.

3.3.6 If a controller declines to be observed, the observer should simply withdraw. The observer should inform the project manager at the earliest convenience about this and, if known, provide any rationale for the refusal that the controller may have offered. While it is not necessary for the project manager to know the identity of the controller who has refused, it is important that the project manager determine if this was merely an isolated event or if the refusal was due to a bigger issue, such as a lack of understanding of the goals of NOSS or a miscommunication. With this knowledge, the project manager will be able to decide on remedial actions when appropriate.

Note.— Observers must refrain from asking a controller the reason for a refusal. If controllers were required to justify their decision, it would jeopardize the principle of voluntary participation.

3.4 THE USE OF NOSS FORMS

3.4.1 After conducting an observation, the observers fill out a structured form to summarize the events that occurred during the observation. The information recorded on this form should convey what was seen to readers who were not present during the observation, and should consist of factual statements. The use of evaluative or judgemental expressions should be avoided. Observation reports should be written up immediately after conducting the observation, at a location other than where the observation was conducted. Care should be taken to avoid writing any information in the observation report that could be used to identify the individuals who were controlling traffic during the observation(s).

Note.— A sample NOSS observation form is presented in Appendix B.

3.4.2 The observation form typically comprises the following sections:

a) *Demographics.* Specifies where an observation was conducted as well some information about the observer.

Observer information

Observer ID		How many times have you observed this group?	
Overall, how many observations have you conducted prior to this one?			

Observation demographics

Group		Sector(s)	
Observation start time (HH:MM) UTC		End time (HH:MM) UTC	

Team composition: What other positions are staffed?

Team position

b) *Traffic picture at the beginning of the observation. O*bservers should describe the current traffic picture and note any threats (e.g. weather, equipment outages) that are present in the environment as they initiate their observation. Observers should then highlight how conditions change during the course of the observation.

Traffic picture as the observation begins

Narrative	Your narrative should provide a context. Describe the traffic picture as you begin your observation. This description should depict the traffic flow and complexity.

Example:

An air force exercise was about to recommence at 04:00 hours; at which time there would be restricted areas covering most of the sector's airspace. The lowest usable level over the restricted areas would be FL 320, FL 270 and FL 210. Those areas were depicted on the screen; with the respective lowest levels depicted in each area. The area with lowest level 320 covered an area of estimated more than 50 per cent of the sector's airspace. There were two aircraft on the frequency of the sector at the start of the observation, and another two or three pending. The aircraft on the frequency were not in conflict with each other, and both at or above the lowest level for the restricted areas they would overfly.

The weather in the sector was generally good, with a 100 knot westerly wind around FL 120.

c) *Observation narrative.* The narrative should provide "the story of the observation" that includes detailed descriptions of all the threats, errors and undesired states observed, in addition to other contextual information that could help better understand the TEM components. The narrative describes what happened during the observation to those not present at the time of the observation.

The story of the observation

Narrative	Your narrative should provide a context. Describe how the traffic flow changes during the course of the observation. What challenges had to be met? How did the controller/team manage threats, errors and undesired states? How did the team/controller interact with: a) pilots; b) other controllers; c) their equipment? What did the team/controller do well? What did the team/controller do poorly? Also, be sure to justify your countermeasure markers.

Example (extract, covering the first 12 minutes of the observation):

At 03:55 a call came in to remind the ATCO that at 04:30 the military restricted areas would go active again. As this time differed by 30 minutes from what the controller had been told before, he queried the caller about the starting time. The caller assured the ATCO that it was 04:30. The ATCO discussed the discrepancy briefly with the controllers to his left and right.

At 03:59 another call came in to inform the ATCO that in one minute the restricted areas would go active and that the earlier information had been incorrect. The ATCO acknowledged the information. He made a comment about the incorrect information to his colleagues left and right and informed them that the areas were active.

The ATCO re-routed a [airline name] flight from [airport] to the northwest. A related system input was made and the new routing was communicated to the flight. The flight acknowledged the new routing. (As this flight was at FL 320, the observer's impression was that the re-routing was not related to the restricted areas becoming active. It rather seemed like an efficiency item.)

04:02 — The ATCO tried to make an input to the label of a [airline name] flight just outside his area (not expected to come into the area, maybe operating below it though), but the system didn't accept the input. There was an asterisk in or near the label, and the ATCO moved over to the position to his left to discuss the reason for that asterisk with the controller at that position. He was not looking at his screen for about a minute; there were two aircraft on his frequency that were not in conflict with each other and above the restricted areas. When returning to his screen the ATCO didn't try to make the input again.

04:06 — A controller who would later take over the working position to the far right in the [name] group approached the ATCO to ask about the purpose of two reporting points at the eastern boundary of the restricted area (and presumably at the interface between the [name] sector and the one about to be occupied by that controller). The ATCO discussed this with her for a while, without looking away from his screen (because they were using the map on that screen to debate the issue). This interaction went on for about a minute and a half.

d) *Position relief briefings.* Highlights the events that were associated with handovers/takeovers or the opening/closing of positions.

Position relief

Narrative	Your narrative should provide a context. How did the controller prepare for the handover? Did the controller stay around the vicinity after unplugging? Were pertinent materials reviewed prior to handover? Were relevant issues covered in the brief? How did the controller get adjusted to the traffic situation? Also, be sure to justify your countermeasure markers.		
Briefing #1	**Briefing time stamp**		

Example:

Just as the ATCO was about to start briefing the incoming controller, there was a call to coordinate a flight inbound [airport name]. The ATCO attended to that call before starting the handover briefing. At 04:33 the briefing was interrupted by a [airline name] flight checking in on the frequency. The ATCO acknowledged the call and subsequently continued with the briefing. The initial part of the briefing focus was on the restricted areas and the strategies the outgoing ATCO had used (or planned to use) for the traffic.

At 04:36 the ATCO handed off the [airline name] flight outbound from [airport name] and informed the pilots that radar service was terminated.

The outgoing ATCO informed the incoming one about the new contact number for the military agency. At 04:38 the ATCO looked at the handover/takeover checklist and followed the items mentioned there to finish briefing the incoming ATCO. After a remark from the controller at the position to the left, the outgoing ATCO transferred the [airline name] flight at FL 410 to the next sector.

The handover/takeover was completed at 04:40. The outgoing controller stayed around for a few minutes to make sure he had covered everything; there were indeed a few minor items that he added at this point.

e) *Overall impressions.* Any personal impressions the observer may wish to share should be made here. Additionally, any items the observer would like to highlight for data verification should be identified here.

Overall impressions

Impressions	This narrative should include your overall impression of the observation. Did you observe anything that you have not seen before? Did you see anything during this observation that would constitute "best practices"? Is there anything else that stood out during this observation? Is there anything you would like to highlight from this observation that was not recorded as a threat, error or undesired state?

Example:

I did score just one error and no undesired states. At all times when the ATCO wasn't looking at his screen the traffic situation was such that no active monitoring would be required for (in my view) a time span even greater than actually used by the ATCO. Separation was assured at all times; there were only one or two aircraft on the frequency whenever the ATCO looked away from his screen. The ATCO showed good judgement in responding to distractions posed by other controllers — I think it was totally reasonable to have those short interactions given the traffic situation at the time.

T3 could possibly be classified as an error. T4, T7 and T8 could possibly be combined into one threat.

e) *Threat, error and undesired state worksheets.* Observers should record all threats, errors and undesired states that they observed during the course of the observation. A description of each of these items should be provided as well as an indication about if and how they were managed by controllers and what their impact on operations was. These worksheets should contain sufficiently detailed information since they serve to inform the data analyst about the threats, errors or undesired states in an observation.

Threat management worksheet

Threat description						**Threat management**
T ID	**Describe the threat**	**Threat code (see code book)**	**Time stamp (HH:MM) UTC**	**Link to position relief or opening/closing of position?** 1. No link 2. Position relief 3. Opening 4. Closing	**Threat outcome** 1. Inconsequential 2. Linked to error	**How did ATCO manage the threat?**
T1						
T2						

Error management worksheet

Error description						Error outcome		Error management
E ID	Describe the error	Error code (see code book)	Time stamp (HH:MM) UTC	Link to position relief or opening/ closing of position? 1. No link 2. Position relief 3. Opening 4. Closing	Link to threat? (if yes, enter threat ID)	Who detected the error? 1. Nobody 2. Radar 3. Flight data 4. Supervisor 5. Controller outside of sector 6. Pilot 7. Automated systems 8. Other	Error outcome 1. Inconsequential 2. Additional error 3. Undesired state	How did ATCO manage the error?
E1								
E2								

Undesired state management worksheet

Undesired state description					Undesired state response/outcome		Undesired state management
US ID	Describe the undesired state	Undesired state code	Time stamp (HH:MM) UTC	Error link	Who detected the undesired state? 1. Nobody 2. Radar 3. Flight data 4. Supervisor 5. Controller outside of sector 6. Pilot 7. Automated systems 8. Other	Undesired state outcome 1. Inconsequential 2. Additional error	How was the undesired state managed?
US 1							
US 2							

3.5 THE USE OF CODES

3.5.1 In the worksheets the observers assign codes to the threats, errors and undesired states they record. Those codes can be found in the code books that are provided with the worksheets. The NOSS code books are living documents, i.e. new items and codes are added to the existing lists as more NOSS experience is gained over time.

3.5.2 Codes for threats exist at three different levels (see Figure 3-1). The observers use the “event description” code, which is the lowest level available. Once the analyst starts entering the codes from multiple observations in a database, the grouping into “threat types” and “threat categories” will become apparent. These are respectively the middle and highest level of codes available. All three levels can be found in the NOSS code books, as depicted in Table 3-1.

3.5.3 The threat category in the Table 3-1 is “ATSP external threats”. The threat types in this category comprise “airport layout”, “airspace infrastructure/design” and “foreign service providers”. The event descriptions are the numbered items in the table; the numbers are the codes.

3.5.4 Codes for errors exist on two levels, i.e. the descriptive level and the “error type” level. Codes for undesired states exist on one level (descriptive) only. However, a distinction is made between the undesired state categories “status/position of traffic” and “status/setup of control position”.

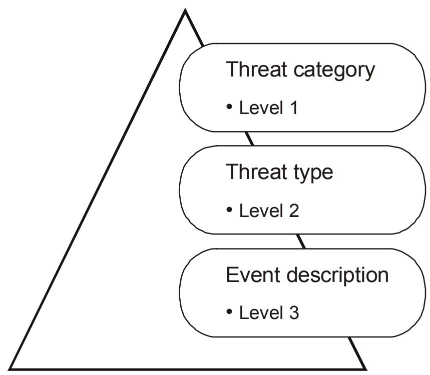

Figure 3-1. The three levels of threat codes

Table 3-1. Threat codes

Air Traffic Service Provider External Threats					
Airport layout		**Airspace infrastructure/design**		**Foreign service providers**	
300	Construction	350	Traffic load	400	Non-standard phraseology
301	Runway contamination	351	Traffic mix (IFR/VFR, aircraft type)	401	Readback error
302	Runway/taxiway configuration	352	Airspace design	402	Communication difficulty
303	Poor signage	353	Restricted airspace	403	Communication channel used
304	Change in active RWY	354	Navaid maintenance	404	Controller system input
999	Other	355	Navaid reliability	406	Coordination issue
		999	Other	409	Aircraft transfer issue

3.5.5 Based on the feedback from the observers, the NOSS facilitator and analyst may have to assign new "event description" codes for threats, errors and/or undesired states that are unique to a particular ATC facility. The integrity of the NOSS coding is preserved by adhering to the main types and categories when assigning new codes.

Note.— A sample version of the NOSS code books is provided in Appendix B to this manual.

3.6 THE NARRATIVE

3.6.1 The most important part of the observation report is the narrative. If the observer provides a rich narrative, any other weaknesses in the observation report can be overcome by extracting information from the narrative. The narrative must provide the contextual information about what occurred during the observation.

3.6.2 The narrative should tell the "story of the observation" in an objective manner. Judgemental interpretations and language should be avoided. Rather, observers should describe what they observed and only what they observed. For example, rather than saying that the workload was low but the complexity was moderate, the observer should provide a description of the situation:

> There were 2 overflights on different tracks and 2 more a/c pending. Additionally 4 a/c needed to be sequenced for approach to XYZ in tight sequence. ZZ135 and ZZ762 were estimating FIXAB at the same time (135 on the _____, 762 on the _____).

3.6.3 The narrative must speak to all of the threats, errors and undesired states observed during the course of the observation. Three pieces of information should be provided for each threat, error and undesired state in the narrative:

a) *Description.* A description of each threat, error and undesired state should be given.

b) *Response.* The observer should indicate how/if the event was either detected/acted upon and what action, if any, was taken to manage the situation

c) *Outcome.* How was the event resolved? What impact did the event have on operations?

3.6.4 In addition to providing the above information on all threats, errors and undesired states, the observer should provide additional contextual information that may be relevant. Such information may not qualify as threats, but may serve as a general update to the traffic picture:

> In the past 10 minutes, 7 aircraft were handed off leaving only one XYZ arrival and one over-flight in the sector. In the next several minutes there would be 2 handoffs from AA sector and 2 departures from ZYX.

Airlines or aircraft types should be identified which could help identify trends or sources of threat.

3.7 STRUCTURING THE NARRATIVES

3.7.1 Narratives are best written using short paragraphs with frequent use of time stamps to allow the reader to locate logged threats, errors and undesired states within the narrative. Time stamps also allow the reader to sequentially follow the events that occurred during an observation.

3.7.2 The logged threats, errors and undesired states should form the core of the narrative. The narrative should then provide additional contextual information that is descriptive in regard to the TEM components. Furthermore, there may be additional contextual information unrelated to TEM components that could aid the reader's global understanding of what was occurring in the working environment during the observation.

3.7.3 An example of a narrative is presented below. The names of the airlines, waypoints and aerodromes that were identified in the original text have been edited to further de-identify the observation report.

Example of a narrative

Narrative	Your narrative should be purely descriptive and provide a context. Describe how the traffic flow changes during the course of the observation. What challenges had to be met? Describe any threats, errors and undesired states, how they were managed and the impact they had on operations. How did the team/controller interact with: a) pilots; b) other controllers; c) their equipment?

At the commencement of the observation there was a relatively high volume of traffic within the sector. 8 southbound flights were present and 1 northbound. All southbound traffic was vertically separated and being placed under their own navigation to [waypoint 1]. [Airport 8] was closed to arriving flights due to fog throughout the observation.

At the beginning of the observation there were 4 aircraft with similar call signs operating in the sector. To prevent any confusion in a time of relatively busy RTF, the controller made a general broadcast to the aircraft involved identifying the problem and advising them to pay attention to instructions. This was a positive and proactive action that kept the situation in hand and effectively elicited the help of the flight crews.

At 07:22 [flight 1] checked in on frequency at [waypoint 2] at F350. [Flight 1] was advised to expect descent in 2 minutes when clear of southbound traffic at F300. The controller indicated that there was less risk by minimally delaying descent than giving an intermediate descent of F310.

At 07:27 [flight 2] was cleared to descend to 8 000 ft. The aircraft did not reply to the instruction. The controller re-established RTF contact with the aircraft then passed on the instruction

At 07:32 while scanning the strips the controller identified a pending confliction between 3 turboprop aircraft 50 NM south of [waypoint 2]. The flights' ETAs indicated that the aircraft would reach [waypoint 2] within 2 minutes of each other. The controller ranged out and rearranged the strips to show the correct arrival order at [waypoint 2]. No action was taken at this point to resolve an altitude confliction between two of the aircraft [flight 4] and [flight 5]. As the aircraft were still some distance from [waypoint 2] the controller may have wanted to allow XYZ sector time to act first.

At 07:35 the controller received a strip on [flight 3] inbound [airport 8]. The controller highlighted the destination on the strip as a reminder of the fog issues.

At 07:36 the controller passed the current ATIS to [flight 6]; however, this transmission was read back by [flight 7]. The controller confirmed with [flight 7] that the information was directed at another flight. The controller then confirmed with [flight 6] that they had the ATIS. This was consistent with the controller's attention to RTF readbacks throughout the observation.

At 07:40 XYZ sector called highlighting the altitude confliction between [flight 4] and [flight 5] at F150 and requested the controller's handling preference. The controller issued a heading of 350° to ensure separation would be in place at the boundary. This was a better resolution to the confliction than an altitude change as it would assist with a later ATM spacing requirement into the terminal environment.

(*this excerpt covers the first third of the observation)*

3.7.4 Most narratives will be a sequential detailing of the threats, errors and undesired states that are observed, augmented by additional contextual information that will allow readers to have an understanding of what occurred during the observation.

3.8 DATA DE-IDENTIFICATION

The observers must not record the names of the individuals at the working positions in the operational environment where the NOSS is conducted. All that is to be recorded is the name of the sector or position that is observed and the start and end times of the observation. The observation form that the observer fills out may contain a code number by which the facilitator can identify the observer, but the observer's name must not be recorded on the form. This guarantees that other persons who see the forms (e.g. during data verification) will not know who wrote the form or who was working the position at the time of the observation.

3.9 NOSS MANAGEMENT/STAFF INTERFACE

To ensure the NOSS runs smoothly, staff should know who the project manager is (and the NOSS facilitator, when applicable) and how he/she can be contacted. It is essential that any issues that arise are resolved quickly and efficiently to cause the minimum of disruption to the observers in the conduct of their tasks.

3.10 OBSERVER SUPPORT DURING OBSERVATIONS

3.10.1 The support provided to the observers during NOSS takes many forms. Some support is achieved through direct person-to-person contact and reassurance. In other instances support is achieved through more indirect means, e.g. skill training or administrative backup. To gain a better understanding of the support required for a successful NOSS, it is useful to look at some of the more specific forms support may take.

Administrative support

3.10.2 There are several important administrative and logistic elements that are required by the observers to perform their tasks. These may include the following:

a) private office space to complete observation reports;

b) access to computer facilities;

c) stationery, e.g. notepads and pens;

d) a timetable of projected training or check shifts for the sectors to be observed;

e) travel and accommodation for out-of-town observers and off-unit observations;

f) roster of planned NOSS shifts;

g) observation quotas for the specific sector.

3.10.3 To simplify the process, it is preferable that the observers have a single point of contact for administrative matters. Any administrative issues that cannot be resolved for the observers should be referred to the project manager for resolution without delay.

Monitoring the quality of data in observation reports as they are received

3.10.4 The NOSS facilitator or the data analyst should constantly monitor the quality of the data in the observation reports received, as well as look for any sensitive issues that may need to be dealt with that observers may have failed to directly notify to the project manager or NOSS facilitator. The analyst in particular should frequently ascertain that the incoming data provide sufficient information so that an informative and representative report can eventually be produced.

Observer motivation and mentoring

3.10.5 Conducting NOSS observations and completing rich observation reports over an extended period requires a very high level of observer motivation and dedication. The motivation element must be continually fostered and nurtured throughout the process. The leadership and interpersonal skills of the project manager (and NOSS facilitator) are key to achieving positive results in this area. The following are some guidelines to assist in the support of the observers through this process:

a) During training it is desirable to foster a strong team feeling between the observers and the project manager (and NOSS facilitator). The relationships should be open and a comfortable environment for free communication fostered. A strong team spirit will help maintain individual motivation through what will prove an intense and challenging time for most.

b) Calibration sessions are very important in determining the quality of the overall result that will be achieved by the NOSS. It is important that these sessions be structured and viewed by the observers as supportive and constructive rather than critical. Their aim should be to develop the observers to the point they can produce a consistent result to the required standard. They are also an excellent forum to provide encouragement and reassurance.

c) Throughout the process and particularly in the early stages of the NOSS, the project manager (and/or NOSS facilitator) should aim to make contact with each observer every 2 to 3 days. The aim of this contact is not just to answer any questions the observers may have, but more importantly to provide an opportunity for the observers to freely chat about their experiences. NOSS by its nature is a confidential process and observers often feel frustrated if they have no outlet to talk about the process. It must be stressed that these conversations should not be about specific observation events, but rather generalized feelings and views about the overall process. Generally after the first observations observers are quite excited and enthusiastic, but also a little daunted by the task that lies ahead. This is a good time for the project manager (or NOSS facilitator) to provide reassurance and encouragement that things are going well or to put in place a plan to rectify any issues that come to light.

d) When the observers are required to conduct a significant number of observations (6 or more) during the NOSS, it is advisable to intersperse the observations with routine operational shifts or provide additional off-duty days. Observer overload can be a significant issue that can potentially affect the quality of observation reports if not managed.

3.10.6 Overall the responsibility for supporting the observers and maintaining their motivation throughout the observations falls on the project manager. The project manager should act as a mentor and provide channels for open and honest two-way communications with the team. The project manager should be responsive to the observers' needs and act quickly to resolve any issues. Sound planning and preparation are the key elements in making a NOSS successful and productive. Well-supported and motivated observers are the key to a successful end result.

Note.— Where a NOSS facilitator is involved, the items assigned to the project manager in the 3.10.5 may be shared between the two.

Chapter 4

DATA VERIFICATION PROCESS

4.1 PURPOSE OF THE DATA VERIFICATION PROCESS

Data-driven programmes, such as NOSS, should employ rigorous data management techniques and quality checks. Therefore, there is a critical quality control step that occurs subsequent to data collection and prior to data analysis. This step is the “data verification” phase. The data verification phase consists of two stages and serves to assure the quality and consistency of the data, as well as to filter out subjective observations made by observers, before the data is analysed. Data verification is a labour-intensive process that may take up to a week to complete (depending on the size of the NOSS). The result is a reliable set of observation data with consistently coded threats, errors and undesired states that are ready to be analysed.

4.2 DESCRIPTION OF THE DATA VERIFICATION PROCESS

4.2.1 The first stage of the data verification process is an initial review of the observations, conducted by an independent analyst. The analyst should reconcile threats, errors and undesired states coded by observers with those noted during their review. Any discrepancies between what the observer and independent analyst have coded should be discussed during the second phase of data verification.

4.2.2 The second phase of data verification utilizes a group of subject matter experts from the organization to review the data points collected by the observer. The group reviews the threats, errors and undesired states logged by the observers to affirm that they should be considered in the analysis. In order to do this, it is necessary to have all relevant reference materials available to consult (national and local procedures, letters of agreement, charts, operations bulletins, etc.). Also at this time, potential threats, errors and undesired states that a post-data collection review of the narratives may indicate that the observers failed to log will be discussed and potentially added. For all TEM components that are included in the data set, the group reviews the coding for each event to ensure proper and consistent coding. Additionally, any biases that observers may be bringing to the data may be addressed at this stage to ensure that personal agendas that might compromise the objectivity of the NOSS data are not included in the data set.

4.2.3 Examples of issues that could be discussed during the data verification process are:

a) An observer coded a coordination event as an error, but a review of the letters of agreement during the data verification process indicates that the coordination was completed according to procedure.

b) An observer coded a particular threat as weather, when in fact a review of the narrative indicates that the threat at hand was due to unserviceable equipment rather than weather. In this instance, the group adjusts the code with the information in the narrative taking precedence.

c) An observer coded an error for each instance the observer heard a controller use non-standard phraseology. In order to be conservative with the data presented in the report, the group would elect to code and count only one non-standard phraseology error since the narrative captures that it happened repeatedly.

Note.— Experience has shown that during data verification the progress is slowest when going over the first reports, but the pace increases once the participants become more comfortable with the process at hand.

4.3 COMPOSITION OF THE DATA VERIFICATION GROUP

4.3.1 The data verification process is typically led by the NOSS facilitator and the data analyst. In addition to the facilitator and the analyst, the data verification group consists of three to five subject matter and operational experts. Suitable participants include, but are not limited to, the NOSS project manager, a (unit) procedures specialist and NOSS observers (preferably with a suitable background, e.g. in instruction or procedure development). Consideration should be given to including a senior representative from the controllers' association (with a suitable background similar to that of the NOSS observer), which will enhance the transparency of the process.

4.3.2 Ideally, the data verification participants would have served as observers and, at a minimum, have attended the NOSS observer training. Whatever the composition of the group, it is important that they be able to have an open and frank discussion of issues that arise during the process.

4.4 UNUSABLE DATA

4.4.1 If during data verification doubt arises concerning the validity of a particular observation report, and this doubt cannot be resolved among the participants, the report is simply put aside and not used for further analysis. Experience from the trials has shown however that the number of discarded observation reports during data verification normally is low, e.g. one or two reports out of a total of 100 or more observations.

4.4.2 The data verification phase is complete when the entire group gives the data analyst approval to proceed with the analysis and report-writing phases.

Chapter 5

DATA ANALYSIS AND PRODUCTION OF THE FINAL REPORT

5.1 ANALYSING THE DATA

5.1.1 Once the data verification process has been completed, the data are ready to be entered into a database. (This step may have already been completed, depending on how and in what form the observation forms were used and sent to the data storage site.) It is recommended that a unique observation number be assigned to every observation — this will be the key identifier across all data sets.

5.1.2 Generally speaking, the analyst will need a software programme that can handle relational databases and can store data sets that contain a lot of text, as well as software that can handle basic statistical analyses.

5.1.3 A number of tables and variables need to be created in the relational database so that later retrieval and data manipulation are as flexible as possible. In short, separate tables are needed for threats, errors, undesired states and for observations.

5.1.4 In the threat table, each row is an individual threat as logged by an observer, and the columns refer to the demographics and threat management variables associated with that threat, e.g. the centre/place, time, observation number, description of the threat and how the threat was managed. The number of rows in the table is equal to the total number of threats observed during the NOSS. Similarly for errors and undesired states, separate tables will allow each row to be an individual error (or undesired state) and the columns to contain all associated information, e.g. demographics of when and where it occurred, how it was handled, if it was detected, the outcome and, of course, the observation number that is used as the identifier to link threats and errors from the same observation.

5.1.5 The observation table differs from the other tables in that each row represents one observation. The number of rows is the total number of observations in the NOSS. As most observations contain more than one threat and more than one error, this information cannot appear on separate rows as with the other tables, but rather the data are summarized so that observation #5 is seen to have 4 threats and 3 errors for example. This table becomes useful for reporting trends across observations, e.g. how many observations had two or more threats, how many observations were error-free, and how many observations at centre X had two or more equipment threats.

5.1.6 The non-text data (demographics, threat and error codes, outcomes coded numerically) can be exported to a statistical programme that will allow quicker analyses. (Again, each table would be a separate data set in the statistical programme.) Frequencies and percentages can be derived quickly. Questions that can be answered include: What percentage of threats/errors was mismanaged? Of all the threats, how many involved equipment? Which centre had more undesired states? The analyst can also cross-tabulate the different types of errors with outcome to determine what types of errors are more likely to be mismanaged.

5.1.7 As the analyst becomes more and more familiar with the “peculiarities” of the data (e.g. higher than expected frequencies, high mismanagement rates for certain errors) he or she will go between the numerical data and the tables containing text, refining searches until the issue can be pinpointed. For example, if centre X appears to have a higher number of airborne threats and more mismanaged airborne threats, the analyst can select those observations that had the mismanaged airborne threats and read what the observers wrote in order to get a more comprehensive picture, and draw conclusions. The better the analyst becomes acquainted with the data, the more specific his/her queries will be. As long as the data have been structured in a flexible format, such as suggested above, the answers can be found.

5.2 WRITING THE REPORT

Note 1.— The final report is normally prepared by the data analyst in cooperation with the facilitator.

Note 2.— The attributes of the NOSS facilitator and the data analyst are provided in Appendix E.

5.2.1 There are many ways to write a NOSS report. One is to start at the broad level and talk about generic findings for threats, errors and undesired states. From there, more specific findings can be highlighted at the sub-category and even individual TEM component level. Ideally, the report lays out the emerging patterns of strengths and vulnerabilities within the operation in a way that the reader can also see those patterns. From there, suggestions can be made as to targets for investigation and improvement. However, these suggestions should be offered tentatively because it is possible that other individuals in the organization may interpret things differently or have alternative explanations for the findings. The report is best offered as an “Initial report of findings”. This way, further analyses are possible as other individuals pursue patterns and answers in the data.

5.2.2 Care must be taken in processing and analysing the data because small mistakes can lead to large inaccuracies in the final product. It is important to double-check all work, and it is preferable if a second individual can review the analyst’s work and look for errors. These reviews need to be at both the analysis and report-writing phase as mistakes at this level could actually be detrimental to the organization if incorrect information is presented.

5.2.3 The analysis and report will vary depending on the type and number of working positions observed and what actually occurred in that airspace. The most important factor in ensuring a high quality report is for the analyst/report writer to be intimately familiar with both the data and the narratives in order to extract the maximum amount of information from the NOSS data. At the same time, care must be taken not to draw overly definitive conclusions if there are only limited data highlighting particular issues.

5.3 OUTLINE FOR THE NOSS REPORT

5.3.1 It is proposed that, as a minimum, the NOSS report comprises the following sections:

a) Section 1. Introduction and executive summary

b) Section 2. Threat profile of [the ATSP]

c) Section 3. Error profile of [the ATSP]

d) Section 4. Undesired state profile of [the ATSP]

e) Section 5. Identified good practices

f) Section 6. Lessons learned by conducting the NOSS

g) Section 7. Closing comments

h) Appendices (may be added as required, e.g. the forms and code books used).

5.3.2 Consideration should be given to providing a set of "raw data" (i.e. the narratives from the observations) with the report to the ATSP for the purpose of conducting future analyses. (See also Chapter 6.)

Note.— For convenience the raw data can be provided in electronic format, e.g. on a compact disc or DVD.

Chapter 6

USING THE NOSS RESULTS IN THE ORGANIZATION

6.1 GENERAL

As was mentioned earlier, NOSS is a diagnostic tool only. It provides an overview of the "TEM strengths and weaknesses" of the ATC operations observed, but it does not provide any remedies or solutions for problem areas that may have been identified. In that respect the NOSS report is the start rather than the end of a safety management process. The ATSP receiving the report must act on the findings presented in it for the report (and thereby the NOSS project) to have any noticeable effects on safety in the organization. Just as with a physical health check, knowing what is right and what is wrong is one thing, but acting on that information in a responsible way is what will ultimately make a person healthier.

6.2 PRESENTATION OF THE NOSS REPORT TO THE ORGANIZATION

6.2.1 The NOSS report contains a significant amount of statistical data that are best interpreted by someone having a firm understanding of the underlying theoretical foundation established by the TEM framework to ensure effective insight into, and consensus on, safety trends and to avoid potential misinterpretation. For example, certain patterns of errors may be interpreted as reflecting non-standard practices of a particular group, when in fact the patterns of errors are highlighting some aspect of the operational environment (e.g. airspace design, procedures) that is leading to such errors. For this reason it is unwise that the raw statistical data be released for general consumption. It is more useful if information from the report is used for specific briefings at an appropriate level for each of the projected audiences. This does not mean that information should be excluded or added for specific groups, but rather the style and level of the presentation should be varied. The most logical persons to prepare and present those briefings are the project manager and the facilitator (if applicable).

6.2.2 Face-to-face briefings should be carefully planned for each group. Senior management are likely to require an in-depth briefing with sufficient time for questions and discussions in an open environment where they can speak freely and frankly. It may therefore be inappropriate to include union and staff groups in these briefings unless specifically invited by senior management.

Note.— It is essential to begin briefings for each group by reviewing TEM concepts and the NOSS process, including how the data were collected and handled.

6.2.3 It should be highlighted at all briefings that while formally the delivery of the report is the final outcome of NOSS, it also is the starting point of a safety management process that will evaluate the report findings in conjunction with other information sources within the organization. It should also be stressed that not all findings highlighted in the report will necessarily be acted on, particularly when the level of risk they pose can be adequately managed.

6.3 MANAGING THE NOSS REPORT

NOSS will provide a large volume of data covering all areas of the observed environment. To maximize the positive outputs to be gained from this data, a planning framework should be established that determines the responsibilities and actions required to manage the report. This planning framework should include, but not be limited to, the following:

a) the appointment of a report sponsor or steering group;

b) the appointment of a senior manager to oversee the processing of the report;

c) establishment of a timetable of key events, from the receipt of the report to the final review;

d) the formulation of a communication strategy for management and staff which should including face-to-face briefings;

e) the appointment of an individual or team who will be responsible for evaluating the report;

f) a decision on who will receive the findings and recommendations from the report;

g) a decision on who will be responsible for taking action on the recommendations from the report;

h) establishment of a review process for any implemented changes;

i) establishment of a review process for lessons learned from the NOSS process.

6.4 SELECTING TARGETS FOR SAFETY ENHANCEMENTS

6.4.1 The recommendations from the NOSS report will indicate targets in the organization for safety enhancements. Yet it is up to the organization to determine which changes are going to be made and at what moment in time in the operational processes. The NOSS recommendations can be integrated with those from other elements of the safety management system in the organization, e.g. incident investigation or voluntary reporting systems. By doing so it is likely that the organization will apply its resources in the best possible way to enhance safety in its operations.

6.4.2 Guidance on which targets to select first is difficult to provide for it will depend greatly on the particular circumstances of the operations of each ATSP. Threats that occur infrequently but are often mismanaged would be a category of potential targets. However this applies similarly for threats that occur frequently and are generally well managed, e.g. runway crossings by tow aircraft and/or service vehicles. Even though the crossings appear to be well managed by the ATC crews, close attention of the controllers is required each and every time the runway is crossed. By constructing a taxi track or service road around the runway, the threat can be removed (or its frequency of occurring reduced), thus making the operation more safe and potentially increasing the runway capacity at the same time.

6.4.3 One of the ATSPs that was involved in the NOSS trials decided to form a “post-NOSS committee” that was tasked to act upon the data derived from the NOSS, together with the feedback received during briefings for the management, controllers and observers. The committee members comprised the manager of the ACC where the NOSS was held, the NOSS project manager and a controller representative from each of the observed ATC specialties. The terms of reference of the post-NOSS committee were as follows:

a) identify targets for enhancement based upon the feedback from the various NOSS data sources;

b) identify and select the group(s) which will come up with recommendations to address the targets;

c) arrange for appropriate resources for these groups to complete their tasks, as well as define milestones and dates of completion;

d) review and endorse recommendations that best address the selected targets;

e) provide progress reports and feedback to operational staff on the committee's efforts on a periodic basis.

6.4.4 The committee selected a number of targets for enhancement. To gather additional feedback from controllers, a series of controller focus groups were conducted with the aim of identifying solutions for the selected targets.

6.5 USE OF THE NOSS DATA FOR COMPARATIVE PURPOSES

The NOSS data are a valuable source of reference information. The data comprise the analysis as presented in the report, but also the "raw data", i.e. the reports from all the observations that were performed during the NOSS. The raw data enable the ATSP to revisit items that were identified in the NOSS report and conduct a more detailed analysis, e.g. on specific aspects of the operations. The raw data are usually provided separately from the report, e.g. on CD or DVD ROM. The narratives give context to actions that are often not available by any other means. This insight can be extremely useful in many situations from incident investigation to procedure design. For this reason it is important that the report be made widely available to safety managers as a reference and validation tool. It is this use of NOSS data in conjunction with other safety related data sources that will produce the most fruitful results. It should always be remembered that the NOSS report is only one of many components of a mature safety management system.

6.6 EVALUATION OF THE NOSS PROJECT IN THE ORGANIZATION

After the report has been delivered to the organization, it is recommended that an evaluation of the NOSS project be conducted. The purpose of this evaluation is to compare the outcome of the NOSS project with the initial aims and intentions for conducting a NOSS. The findings from the evaluation can be applied in any subsequent NOSS projects the organization may decide to undertake.

6.7 CONDUCTING A FOLLOW-UP NOSS

6.7.1 After a NOSS has been conducted, the results of the report have been analysed and processed by the ATSP and appropriate safety changes have been proposed and implemented, NOSS can be used as a tool to measure the effectiveness of the changes made (see Figure 6-1). To that end a follow-up NOSS can be conducted on the same target(s), and the results of this second NOSS can be compared with those of the first one. It is recommended to allow an adequate time span between successive NOSSs with the same target(s), in order for safety changes to take effect before they are re-measured.

6.7.2 For a follow-up NOSS the same preparations are required as for a first NOSS (e.g. the publicity phase, observer selection, observer training), even though the same individuals may be involved. Since participating in a NOSS is not a part of an everyday routine, an individual's skills and knowledge about the process will have faded and need to be re-built just as carefully as the first time.

Note.— It may be necessary to produce a new joint letter of support from the ATSP management and the controllers' association (e.g. as a result of personnel changes on the Board).

6.8 CONDUCTING ANOTHER NOSS AT A DIFFERENT LOCATION AND/OR WITH A DIFFERENT TARGET

Once a NOSS project has been successfully concluded, an ATSP may decide to conduct another NOSS at a different location and/or with a different target (which could be a smaller element of the first NOSS). There is no need to wait a number of years to conduct this "new" NOSS, for it will constitute a "first" for the location or target where it is conducted. If a sufficient number of different locations and/or targets can be selected, an ATSP can design a multi-year NOSS programme that successively covers the operations of the ATSP in periodic cycles.

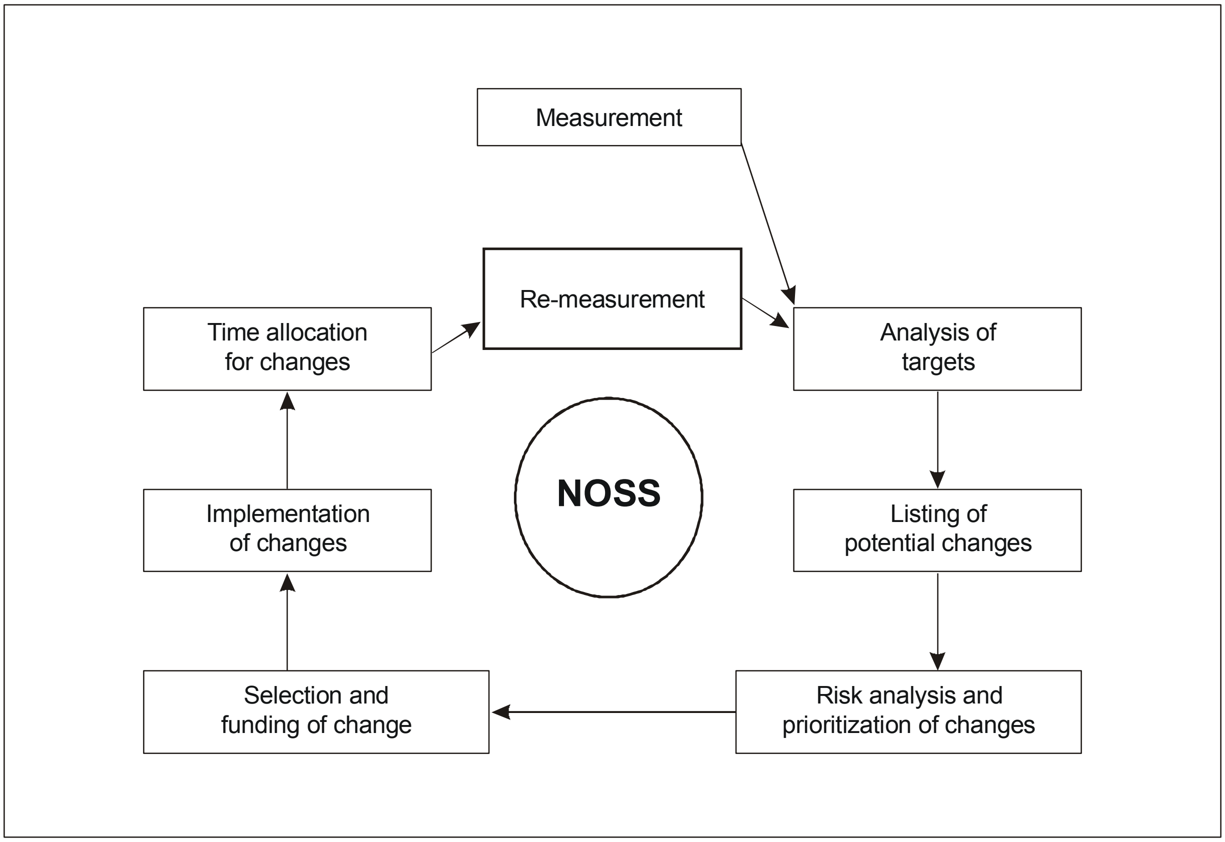

Figure 6-1. NOSS as a tool to measure the effectiveness of changes

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Appendix A

THREAT AND ERROR MANAGEMENT IN AIR TRAFFIC CONTROL

1. When the TEM framework is introduced to operational aviation personnel (air traffic controllers, pilots, etc.) the common reaction is one of recognition. Operational personnel have been aware of the factors that are considered as "threats" in the TEM framework almost since the start of their aviation careers. The difference is that this awareness used to be implicit whereas the TEM framework makes it explicit, principled and therefore manageable. The following two scenarios are proposed to assist ATC staff to understand TEM.

2. In an ideal context, a generic ATC shift could develop along the following lines:

a) The Air Traffic Controller (ATCO) reports for duty ahead of the official starting time of the shift. The ATCO checks the daily briefing material available in a well-organized and clear format. Before taking over the working position from a colleague, the ATCO receives the last update on that day's weather situation and the technical status of the ATC equipment from the unit supervisor.

b) After plugging in the headset at the assigned working position, the ATCO spends a few minutes just listening to the communications between the colleague she is replacing and the traffic that the colleague is handling. The ATCO then indicates to her colleague that she is ready to take over, so the colleague briefs her on tasks that are pending and the short-term agreements that are in place at that time with adjacent air traffic control positions.

c) After the ATCO takes over the position and begins communicating with the traffic, her colleague remains at her side for a few minutes in order to ensure that the handover goes smoothly and nothing is forgotten. Once the controllers are both convinced that this is the case the colleague leaves to go on his rest break.

d) During the shift the weather remains fine, just as predicted, with a wind from a direction that is fully compatible with the runways in use. There are no technical problems with the ATC equipment and there is no maintenance work scheduled that day.

e) The traffic flow is sufficiently challenging to keep the ATCO occupied without overloading her. There are several complex traffic situations developing during the shift, but the ATCO is able to resolve these by issuing timely and concise instructions to the pilots concerned who cooperate fully to ensure a safe, orderly and expeditious flow of traffic.

f) After an hour and a half a relief colleague returns to take over the position from the ATCO. The colleague listens to the communications and monitors the traffic situation, after which he indicates that he is ready to take over. The ATCO lets the colleague assume responsibility for the traffic, but stays at his side for a few minutes to update him on the latest agreements with other control positions and the tasks that are still pending. Once convinced her colleague is comfortable at the position, the ATCO leaves the operations room and goes on a break.

g) The ATCO works two further sessions at different working positions after this first break. The traffic is challenging yet manageable, the weather remains fine as predicted, and there are no technical problems.

3. However, ideal contexts do not exist so this is how a shift could develop in reality:

a) The Air Traffic Controller (ATCO) reports just in time for duty. After arriving in the operations room, the ATCO goes straight to the position that he is supposed to take over. The ATCO barely has time to look at the traffic situation and plug in before the colleague walks away from the control position.

b) The traffic situation is complex and quite different from the way the ATCO would like to have it organized. The ATCO spends some time rearranging the setup of the ATC equipment and discovers that not all functionality of the automated system is available. Next the ATCO calls an adjacent control position to arrange the handover of one particular flight, only to be told that a temporary arrangement was in place with the colleague that covers all such handovers for the next two hours.

c) The meteorology office has forecasted deteriorating weather, but the ATCO is not aware of it since he did not look at the forecast before taking over the working position. Consequently the weather change comes as a surprise, and he is pressed to stay on top of the traffic while adapting to the new situation.

d) After more than two hours with heavy and complex traffic, the ATCO is relieved by a colleague who plugs in the headset and states that he is assuming responsibility for the position as of that moment. The ATCO walks away immediately, in order to rest before taking over the next position 15 minutes later.

e) In the subsequent session the ATCO works a position with little traffic. Due to distraction, the ATCO misses several initial calls from aircraft and responds only to their second calls. The ATCO also has to be reminded by colleagues that he needs to transfer traffic to their frequencies but, of course, he manages to do this well before the sector boundary.

f) After another short break, during which the ATCO attended to some urgent paperwork, he is back on a position with complex and heavy traffic. While engaged in busy communications with aircraft and other control positions, a technician arrives and asks if he can start testing the secondary radio channels as per the maintenance schedule. Since the work is according to a schedule obviously approved by management, the ATCO agrees reluctantly. Two more technicians appear and they all start working on the equipment near the ATCO, while he is controlling his traffic.

g) The ATCO then notices that the radios are not working properly. He asks the technicians to stop working and reaches for the emergency radio set. It takes a few moments to select the appropriate frequencies, but communications can be resumed using the emergency set. The traffic was not affected by the radio failure and separation was maintained at all times. The technicians undo the mistake that caused the main radio to fail and, after a few minutes, the ATCO can again communicate normally.

4. Of the scenarios presented above, the second would be the one that most operational air traffic controllers would identify with more easily. Also, to other persons, the differences between the scenarios will be easy to spot and the first scenario will appear less realistic than the second one. What may not be immediately apparent however — and perhaps can not be emphasized strongly enough — is that even in the second scenario there are few events — if any — that would be likely to be reported under conventional safety reporting systems. In other words, the second scenario would be considered a normal shift in most, if not all, air traffic services (ATS) organizations. Yet there are several elements in the scenario that can affect safety, particularly when they are not managed adequately by the air traffic controller. These elements are the threats in the TEM framework.

Appendix B

NOSS OBSERVATION FORMS AND CODE BOOKS

Note.— This Appendix is reproduced with the kind permission of the University of Texas at Austin.

Observer information

Observer ID		How many times have you observed this specialty?	
Overall, how many observations have you conducted?			

Observation demographics

Specialty		Sector(s)	
Observation start time (HH:MM) UTC		End time (HH:MM) UTC	

Traffic picture as the observation begins

Narrative	Your narrative should provide a context. Describe the traffic picture as you begin your observation. Are pieces of equipment unserviceable? Is weather impacting the traffic scenario? This description should depict the current traffic flow and complexity.

The story of the observation

Narrative	Your narrative should provide a context. Describe how the traffic flow changes during the course of the observation. What challenges had to be met? How did the controller/team manage threats, errors, and undesired states? How did the team/controller interact with: a) pilots b) other controllers c) their equipment? What did the team/controller do well? What did the team/controller do poorly? Also, be sure to justify your countermeasure markers.

Position relief

Narrative	Your narrative should provide a context. How did the controller prepare for the handover? Did the controller stay around the vicinity after unplugging? Were pertinent materials reviewed prior to handover? Were relevant issues covered in the brief? How did the controller get adjusted to the traffic situation? Also, be sure to justify your countermeasure markers.		
Briefing #1	**Briefing time stamp**		
Briefing #2	**Briefing time stamp**		

Best practices

Did you observe anything that the controller did particularly well during this observation?

Overall impressions

Use this section to provide an overall impression of what you observed and to raise issues that you consider the data cleaning team should consider. For example a threat or error that does not have an appropriate code.

Threat management worksheet

Threat description						Threat management/outcome
T ID	Describe the threat	Threat code (see code book)	Time stamp (HH:MM) UTC	Link to position relief or opening/closing of position? 1. No link 2. Position relief 3. Opening 4. Closing	Threat outcome 1. Inconsequential 2. Linked to error	How did ATCO manage the threat? What impact did the threat have on operations?
T1						
T2						
T3						
T4						
T5						
T6						
Threat codes: see the NOSS code book for threat codes.						

Error management worksheet

Error description						Error outcome		Error management
E ID	**Describe the controller error**	**Error code (see code book)**	**Time stamp (HH:MM) UTC**	**Link to position relief or opening/closing of position?** 1. No link 2. Position relief 3. Opening 4. Closing	**Link to threat? (if yes, enter threat ID; i.e. T4)**	**Who detected the error?** 1. Nobody 2. Radar 3. Flight data 4. Supervisor 5. Controller outside of sector 6. Pilot 7. Automated systems 8. Other	**Error outcome** 1. Inconsequential 2. Additional error 3. Undesired state	**How did ATCO manage the error?**
E1								
E2								
E3								
E4								

Undesired state management worksheet

Undesired state description					Undesired state response/outcome		Undesired state management
US ID	**Describe the undesired state**	**Undesired state code**	**Time stamp (HH:MM) UTC**	**Error link**	**Who detected the undesired state?** 1. Nobody 2. Radar 3. Flight data 4. Supervisor 5. Controller outside of sector 6. Pilot 7. Automated systems 8. Other	**Undesired state outcome** 1. Inconsequential 2. Additional error	**How was the undesired state managed?**
US 1							
US 2							
US 3							

Threat code book

Internal threats							
Equipment/workspace threats				**Other controller/flight data**		**Operational performance threats**	
101	Radios	114	Visitors	141	Early/late transfer	181	Procedure
102	Telephones	115	Poor sight lines	142	Non-standard phraseology by other controller	182	Flow control command
103	Traffic display event (radar screen)	116	Lighting	143	Incomplete readback by other controller	183	Non-standard level
104	Radar coverage	117	Chart/manual error	144	Communication difficulty with other controller	184	Non-duty runway usage
105	Frequency coverage	118	Windows (dirty, spots, etc.)	145	Communication channel used by other controller	185	Change in duty runway
106	Screen clutter	119	Automated handoff failure	146	Controller system input	186	Diversions
107	Unserviceable equipment	120	Navigation aid issue	147	Coordination issue	187	Priority flight/VIPs
108	Data incongruence between ATS systems	121	Flight plan — ATS system incongruence	148	Strip issue	188	Sequencing issue
109	Software/equipment issue	122	Equipment maintenance	149	Radar-data controller interaction	189	Combined/de-combined sectors (outside of normal configuration)
110	False system alarm	123	Equipment failure (failed during observation)	150	ADC-SMC interaction	190	Other operational demand threat
111	Equipment checks	139	Other equipment/ workspace threat	151	Supervisory action		
112	Noise			152	Flight plan error — controller		
113	Difficult to access reference materials			153	Unspecified controller threat		
				154	Incorrect readback by other controller		
				171	Non-operational conversation		

Airborne Threats					
Aircraft pilot issues		**R/T communication**		**Traffic**	
221	Aircraft not identifying	201	Pilot incomplete readback	261	Traffic mix
222	Heading deviation	202	Pilot non-standard phraseology	262	Military flights
223	Speed deviation	203	Pilot language difficulty	263	Parachute activity
224	Altitude deviation	204	Pilot failure to respond to call	264	Pop-up flight
225	Routing deviation	205	Frequency congestion/calls stepped on	265	Formation flight
226	Combo deviations (heading, altitude, speed, etc.)	206	Blocked frequency	266	Survey flight
227	Aircraft slow to comply with command	207	Pilot communication difficulty	267	Training flight
228	Flight crew failure to report	208	Pilot use of incorrect call sign	268	Hot air balloon
229	Aircraft equipment	209	Aircraft answering call for another aircraft	269	Similar call signs
260	Rate of climb/descent	210	Pilot incorrect readback	270	Meteorological balloon release
231	Pilot unable to comply with instruction	219	Other R/T communication threat	271	Special VFR
232	Closing speed/overtake			272	Flight check
233	Aircraft emergency			273	Search and rescue action
234	Airline procedure			289	Other traffic threat
235	Non-standard aircraft profile				
236	Runway occupied longer than expected				
237	Pilot taxi error				
238	Pilot SSR code error				
239	Pilot SSR code error — pilot				
240	Pilot estimate error				
241	Non-RVSM aircraft in RVSM airspace				
242	Other (miscellaneous) pilot error				
243	Pilot request				
244	Flight plan issue — pilot/airline				
245	Fuel issue				
259	Other pilot/aircraft performance threat				

Air traffic service provider external threats					
Airport layout		**Airspace infrastructure/design**		**Foreign service providers**	
301	Ground construction	321	Airspace design	341	External ATSP — Non-standard phraseology
302	Runway contamination	322	Restricted airspace	342	External ATSP — Readback error
303	Runway/taxiway configuration	339	Other airspace threats	343	External ATSP — Communication difficulty
304	Poor signage			344	External ATSP — Communication channel used by other controller
305	Taxiway closures			345	External ATSP — Controller system input
306	Airport layout			346	External ATSP — Equipment
307	Bird activity			347	External ATSP — Coordination issue
308	Ground stop			348	External ATSP — Aircraft transfer issue
319	Other airport threats			349	External ATSP — Flight plan error — external controller
				359	Other external ATSP threats

Environmental threats			
Weather (WX) threats		**Geographical environment**	
361	Thunderstorms with turbulence	381	Sun/glare (natural light)
362	Turbulence (only)	382	Terrain
363	Icing	383	Noise abatement
364	Wind shear	398	Other geographical threats
365	Winds	399	Other threats
366	Visibility — meteorological		
367	Cloud base		
368	Combination/multiple WX threats		
379	Other weather threats		

Error code book

Position relief errors			
501	Incomplete position relief briefing	503	Did not open an position when conditions dictated
502	Checklist not used	509	Other position change error

Communication errors			
511	Incomplete readback not challenged	520	Aircraft type omitted in initial call
512	Incorrect readback given	521	Call sign omission/truncation
514	Incorrect readback not challenged	522	Clipped call
515	Wrong call sign used	523	No station identification on initial contact
516	Non-standard phraseology	524	Frequency change below 1 000 ft
517	Missed call	539	Other communication error

Equipment/automation errors			
541	Computer/automation input error	546	Communication system manipulation error
542	Incomplete/inaccurate information display on screen	547	Aerodrome lighting error
543	Radar screen range selection	548	Screen setup
544	Data tag information obscured	549	Flight plan not updated
545	Data tag incomplete/inaccurate information	559	Other equipment/automation error

Flight data progress strip errors			
561	Flight progress strip manipulation	568	No altitude written on strip
562	Flight progress strip marking error	569	Coordination not indicated on strip
563	Assigned speed not noted on strip	570	Aircraft verified level, not marked on strip
564	Combined strip writing/manipulation	571	Strip not indicating required action
565	Times not written on strips	572	Blocking strip not used (e.g. for occupied RWY)
566	No strip on board for an aircraft	573	Strip marked too early
567	Flight data board out of sequence	599	Other strip marking error

Procedural errors			
601	Non-operational conversation	617	Failure to respond to unanswered call
574	Flight plan not updated	618	No/late response to alarm
575	Did not scan TWY	619	Recorded line not used
576	Did not monitor take-off/landing	620	Failure to monitor traffic situation (e.g. not looking at screen for prolonged periods)
577	Visual separation provided with aircraft that was not on frequency	621	No level verification
578	Non-standard allocation of duties within the controller team	622	No identification of aircraft
579	New information not checked (weather, etc.)	623	Wake turbulence application

Procedural errors			
580	Reasonable priority not given to emergency flight/vehicle	624	Inappropriate accommodation of pilot request
581	Failure to act on aircraft deviation	625	Inappropriate accommodation of controller request
582	Estimate error	626	Minimum vectoring altitude issued to aircraft not on vectors
583	Inappropriate search and rescue response	627	Radar services not terminated
611	Late coordination	628	Late/no issuance of landing clearance
612	No coordination	629	Reasons for vectoring not given
613	Failure to respond to unanswered call	630	Did not pass information (traffic, terrain, etc.) to aircraft
614	Coordination with wrong sector	631	Incomplete/incorrect information given during coordination
615	No conflict check	639	Other procedural error
616	No visual scan of RWY		

Aircraft instruction errors			
641	Incorrect information passed to aircraft	647	Transponder/altimeter instruction error
642	Incorrect frequency issued	648	Heading instruction error
643	Late descent	649	Hold instruction error
644	Late change	650	Clearance instruction error
645	Altitude instruction error	651	Taxi instruction error
646	Speed instruction error	659	Other aircraft instruction error

Undesired state code book

Workspace position undesired states			
941	Inaccurate representation of traffic	945	Entire airspace not displayed
942	Traffic display not being monitored for prolonged period of time	946	Controller position not opened
943	Frequency not being monitored	959	Other control position undesired state
944	Faulty equipment being used		

Traffic undesired states			
901	Unauthorized provision of services	912	Restricted airspace not protected
902	Lack of separation assurance	913	Lack of separation assurance — taxiways
903	Uncoordinated movements in another controller's airspace	914	Very late issuance of landing clearance
904	Aircraft climbing/descending to different altitude/level than coordinated	915	Aircraft not protected from wake turbulence
905	Aircraft at other altitude/level than coordinated	916	Aircraft taxiing to point other than instructed
906	Aircraft at other heading/track than coordinated	917	Airspace penetration
907	Aircraft at other speed than coordinated	918	Aircraft not in possession of important information
908	Aircraft taxiing towards runway without instruction to hold short or clearance to enter/cross the runway	919	Expired SAR time not investigated
909	Aircraft not in contact with ATC	920	Aircraft provided incorrect information
910	Two (or more) users cleared to occupy a runway at the same time	921	Separation standards being applied based on faulty data
911	Two (or more) aircraft cleared to the same point in space (3D) at the same time	939	Other traffic undesired states

Appendix C

EXECUTIVE SUMMARY

1.1 OVERVIEW AND BRIEF DESCRIPTION

1.1.1 The Normal Operations Safety Survey (NOSS) is a methodology for the collection of safety data during normal air traffic control (ATC) operations. A normal ATC operation is defined as an operation during the course of which no accident, incident or event takes place of which the reporting and/or investigation are required under existing legislation or regulations. Training and check shifts are considered to be outside the scope of normal operations.

1.1.2 By conducting a series of targeted observations of ATC operations over a specific period of time, and the subsequent analysis of the data thus obtained, the organization is provided with an overview of the most pertinent threats, errors and undesired states that air traffic controllers must manage on a daily basis. One feature of NOSS is that it identifies threats, errors and undesired states that are specific to an organization's particular operational context, as well as how those threats, errors and undesired states are managed by air traffic controllers during normal operations. The information thus obtained will enhance the organization's ability to proactively make changes in its safety process without having to experience an incident or accident.

1.2 RELATIONSHIP TO THE SAFETY MANAGEMENT SYSTEM

Safety data from NOSS are data that are not otherwise available. As such they complement the traditional sources of data of a safety management system. NOSS is regarded as a component of an ATC safety management system (SMS).

1.3 SCOPE OF NOSS

NOSS is intended as a safety management tool for the SMS of the organization. NOSS is founded on scientific principles and, in particular, on the Threat and Error Management (TEM) framework. NOSS is a method developed for application in the operational environment. Rather than being a tool to assess individual controller behaviour or controller productivity, NOSS will provide the organization with a picture of the most pertinent threats and errors in a specific operation, how they are managed and how effectively any resulting undesired states are managed during normal ATC operations.

1.4 PURPOSE OF NOSS

The purpose of conducting a NOSS in an organization is to find out what are the most pertinent threats and errors that controllers have to manage during normal operations and how these are managed. NOSS thus captures ATC system performance through the eyes of the air traffic controllers. Once that information is available, the SMS of the organization can propose adjustments in the operational processes as required (e.g. changes in procedures, or specific safety topics for recurrent training programmes for air traffic controllers) as countermeasures to the threats and errors that the controllers are confronted with on a daily basis. By conducting follow-up NOSSs, an organization will be provided with feedback on the effects of its safety change process since the previous NOSS.

1.5 ADDED VALUE OF NOSS

Conventional safety data collection programmes mainly present data from abnormal operations, i.e. data about situations that went wrong, or failed system/human performance data. Furthermore, data collection is traditionally outcome-driven, i.e. some triggering event must take place in order for the programme to capture safety data. NOSS provides data about normal situations, i.e. where situations resulted in uneventful outcomes, or successful system/human performance data. The NOSS data include information about the effect of specific countermeasures on managing threats, errors and/or undesired states, which is an indication of the success of existing safety strategies in the operations of the organization. Furthermore, NOSS data are process-driven, i.e. there is no need for a triggering event to take place in order for the programme to capture safety data.

1.6 BENEFITS OF NOSS

- Proactive hazard identification
- Prioritized safety actions
- Enhanced understanding of air safety incident trends
- Converging lines of evidence
- Identification of areas of strength
- Improved organizational trust
- Engaged workforce
- Positive cooperation with the regulator
- Exchange of information, industry benchmarking and collaboration with airlines
- Decision support tool
- Verification of the quality and usability of procedures
- An understanding of controller shortcuts and workarounds.

1.7 SPECIFIC OBJECTIVES OF NOSS IMPLEMENTATION

After conducting a NOSS, the organization will be able to set clear targets for safety enhancement of its operations. The effect of changes made can be “measured” by conducting a follow-up or repeat NOSS. In the meantime the effect of changes may be noticeable by comparing specific events trends from the pre- and post-NOSS periods.

1.8 FRAMEWORK OF NOSS

NOSS is based on the Threat and Error Management (TEM) framework as developed by the University of Texas. For a description of TEM in ATC, see ICAO Circular 314 or Appendix A to this manual,

1.9 PREREQUISITES FOR NOSS

Before a NOSS is conducted in an organization there has to be agreement from both the management of the organization and the body or bodies that represent(s) the air traffic controllers. In the agreement the non-disciplinary nature of the data collection process must be emphasized. Furthermore a mechanism has to be agreed for securing the collected data and for preventing that data from being misused. It should be clear that NOSS data are not designed to be used for incident investigation or research purposes. Organizations require a process independent from NOSS for capturing safety data in the event of an incident or accident.

1.10 NOSS DATA

The data from a NOSS programme are intended for use by the SMS of the air traffic service provider organization that conducts the NOSS.

1.11 WHERE IS A NOSS CONDUCTED?

NOSS observations are conducted at the normal operational working position(s) of the observed controller(s). The observers should be as unobtrusive as possible while conducting their observations.

1.12 SUBJECTS OF NOSS OBSERVATIONS

NOSS observations will not be held in on-the-job (OJT) training or check situations. In a typical observation session, lasting up to 1 hour and 30 minutes, a single controller working position will be observed, even if the controller observed is working with another controller as part of a team. Observed controllers will know that they are being observed, and they will also know the purpose of the observation. Controller participation is voluntary, i.e. a controller can refuse to be observed for NOSS purposes.

1.13 NOSS OBSERVERS

The observers for a NOSS programme are selected from the pool of qualified air traffic controllers in the organization. This selection may involve a joint effort by staff representatives and the management of the organization. Experience has shown that observers provide optimal data when observing in a setting outside the one they normally work in; therefore consideration should be given to selecting candidates from other facilities or positions than the one(s) where the NOSS will be held. Candidate observers may also be selected from the (non-operational) instructor group in the organization, or from outside the organization. As a general guideline the number of operationally qualified observers should be no less than 80 per cent of the total number of observers. This adds to an enhanced perception of the validity of the data because the data are collected by peers rather than “outsiders”. The observations are performed by single (individual) observers.

1.14 NOSS OBSERVER TRAINING

Training the NOSS observers is an important element of the pre-data collection phase. The training normally will last up to 5 working days. Focus in the training programme is on the TEM framework, as the observational concept that will guide observers towards what they are expected to look for, and on how to fill in the observation forms. The last days of the training programme comprise “controlled” observations, in which the completed observation forms are analysed with the observers in order to help ensure the consistency and reliability of reports from different observers.

1.15 NOSS DATA COLLECTION AND PROCESSING

All data collected by the observers are reported in a de-identified format in order to guarantee the anonymity of the controllers involved. After all data have been collected, a “data verification round table” is held in which selected observers and key staff from the organization verify all received reports and the coding of the threats, errors and undesired states as applied by the observers. Specialists subsequently analyse the data. Next a detailed report of the results and findings from the NOSS is presented to the management of the organization.

1.16 NOSS DATA OWNERSHIP AND STORAGE

The data from a NOSS is owned by the ATS provider organization that conducted the NOSS. However NOSS data are sensitive material that potentially could be abused if taken out of context. Therefore a trusted site should be selected and assigned to store the data after they have been collected and analysed. Circumstances that can help determine whether or not an air traffic services provider should store NOSS data in-house comprise *inter alia*: the national legislation on freedom of information (i.e. to the press and the public), the status of the air traffic services provider (e.g. part of the government or a corporatized entity) and, last but not least, the need to be able to benchmark or otherwise compare the data with other organizations where a NOSS has been done. Alternative locations for storing NOSS data could include, but are not limited to, universities or aviation research laboratories in the State or region of the air traffic services provider.

Appendix D

SAMPLE SUPPORT LETTER

NORMAL OPERATIONS SAFETY SURVEY (NOSS)

NOSS is to be introduced to [the ATSP] with a trial being conducted in *[location/name of ATC facility]* over a [x]-week period commencing [date].

For this survey, we will be using controllers from [the ATSP] to conduct observations of normal operations, along with an observer from the University of Texas (UT) Human Factors Research Project. The controllers chosen for this exercise were selected jointly by [the ATSP] and [the controllers' association].

NOSS observations are **no-jeopardy** events, and all data are **confidential** and **de-identified**. NOSS data will go directly to the UT Human Factors Research Project for data entry and analysis. Be assured that these observations are not check assessments. The observers are not there to critique individual performance — their mission is to be unobtrusive observers and to fill out data collection forms after the observation has been completed.

The intention of NOSS is to help us identify the strengths and weaknesses of our procedures. With that information, management is committed to making the necessary changes to continually improve the way that we do business. In short, we are conducting a NOSS so that we can improve the system to better support ATC. After the survey has been completed, we are committed to telling you how it went and how we plan to make improvements.

[The ATSP] has sought the involvement of [the controllers' association] from the outset of the implementation of the NOSS. [The controllers' association]'s involvement will assist in assuring that every safeguard possible is put in place and there is no jeopardy to controllers and observer members during the safety survey.

[The controllers' association] wishes to reassure its members that all data and information that are gathered shall be de-identified as to individual controllers or dates, and acknowledge that the survey is of “the system” and not of “the individual”.

On behalf of [the ATSP] and [the controllers' association] we wish to endorse NOSS.

General Manager ATM
[ATSP]

President
[Controllers' association]

Appendix E

ATTRIBUTES OF THE NOSS FACILITATOR AND THE DATA ANALYST

1.1 THE NOSS FACILITATOR

The NOSS facilitator must be a subject matter expert on the NOSS process and an effective facilitator with experience in the operational ATC processes of the organization.

1.2 THE DATA ANALYST (AND REPORT WRITER)

The data analyst must have a research analysis background, with experience in managing and analysing large data sets. The analyst must also have expertise in interpreting results from the data and be able to present the results in a meaningful way (i.e. the report). Last, but not least, the analyst must be a subject matter expert on the TEM framework with respect to NOSS and be familiar with the operational ATC processes in the organization.

Appendix F

PRE-NOSS CHECKLIST

IS THE ORGANIZATION READY FOR NOSS?

To help decide if an organization is ready for NOSS or indeed if NOSS is the right thing for the organization, the following points may be considered. These relate to a number of factors that may indicate whether or not NOSS is appropriate for an organization.

— Are there any reasons why NOSS is a bad idea for the organization or why NOSS is not right for the organization at the present time? Consider the following for example: industrial problems, social or domestic unrest in the organization, strained managerial-workforce relationships, any recent serious incident or accident. (In the aftermath of a serious incident or accident it is not a good idea to introduce NOSS because it will be transformed into a reactive quick fix. Additionally, the effects of post-accident investigations and the potential for critical incident stress and related post-incident manifestations in the workplace need time to stabilize. This may take up to two years.)

— Does the organization have a safety change process in place that can use NOSS-generated data? Is there a commitment to act on such information?

— Are safety targets set for the organization?

— Is there commitment from senior management that action will be taken on the basis of NOSS data? Is senior management prepared to publicly state this in the organization?

— Is there a commitment to a non-punitive (confidential) use of NOSS data?

— Is there a commitment to NOSS over a period of years? Are the resources there?

— How has safety information been used previously in the organization?

— Can feedback generally be freely provided to the controller workforce?

— What has happened to previous safety initiatives? How were these received?

— Does the controllers' union/professional association support NOSS?

— What do key stakeholders think about NOSS? Have they been educated about NOSS and TEM?

— Is there an understanding in the workforce about what NOSS and TEM are? If not can this be provided?

— What is a realistic timeline to implement NOSS? In which areas of the organization should a NOSS first be held?

— Does the regulator require normal operations monitoring? If so does NOSS meet this requirement?

If favourable responses to the questions above can be given, then an organization is likely to succeed in running a NOSS programme. If items above are causing some concern, can they be addressed successfully? If not, then the organization might be better off to reconsider the introduction of NOSS or postpone its introduction until a time when conditions are right.

— END —

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