THE BACKGROUND TO THE DEVELOPMENT OF THE INFORMATION SYSTEM FOR AVIATION SECURITY OVERSIGHT IN RUSSIA

A. Blagorazumov
The State Scientific Research Institute of Civil Aviation,
Mikhalkovskaya Street, 67, building 1, 125438 Moscow, Russia

P. Chernikov, G. Glukhov, A. Karapetyan, V. Shapkin and L. Elisov
The State Scientific Research Institute of Civil Aviation,
Mikhalkovskaya Street, 67, building 1, 125438 Moscow, Russia

ABSTRACT

The article covers implementation in Russia of the Continuous Monitoring Approach (CMA) under the Universal Safety Oversight Audit Programme (USOAP) developed by the International Civil Aviation Organization (ICAO). Authors analyzed the problems arisen during the experts' data collection, processing and submitting to the ICAO and revealed the main causes of those problems: the use of ICAO's original questionnaires as the main tool for keeping and exchanging expert data, as well as complexity of the expert activity coordination in a two-level interaction scheme comprised of a national coordinator and experts. It is demonstrated the need to switch to a three-level interaction scheme that include coordinators for each audit area, and the need to develop an information system, which introduction would allow us to avoid the revealed problems during implementation of the CMA under the Universal Security Audit Programme.

Keywords: civil aviation, aviation security, flight safety, ICAO, continuous monitoring approach, CMA, USAP, USOAP.

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1. INTRODUCTION

Ensuring the aviation security in civil aviation is one of the most important components of the governmental regulatory process in the national aviation activities. Following the events of 11 September 2001, the International Civil Aviation Organization, of which the Russian Federation is a member, adopted Resolution A33-1, Declaration on Misuse of Civil Aircraft as Weapons of Destruction and Other Terrorist Acts Involving Civil Aviation, at the 33rd session of the Assembly (25 September - 5 October, 2001) [1].

On February 19-20, 2002 at the ICAO's headquarters, there was held a Ministerial Level Conference on Aviation Security that was attended by 700 representatives from 153 States and 25 observers. The conference adopted a Declaration on Aviation Security dedicated to further recovery of confidence in international air transport and activation of its operations. [2].

According to Resolution A33-1 and the Declaration on Aviation Security, the ICAO Council at the 14 June 2002 session approved an ICAO Global Aviation Security Plan including regular mandatory audits of aviation security level in all ICAO Member States starting from November 2002. The Universal Security Audit Programme (USAP) was prepared and the Security Audit Reference Manual was published [3].

Resolution A38-15, Consolidated Statement of Continuing ICAO Policies Related to Aviation Security, was adopted at 38th session of the ICAO Assembly (on September 24 - October 4, 2013) declaring the USAP transition from periodic audit of States to the continuous monitoring approach (USAP-CMA). As a help to the ICAO Member States and audit teams, the Continuous Monitoring Manual under the Universal Security Audit Programme[4] was prepared with intention to explain concepts, methodology, processes, and procedures of preparation and conduct of checks and audits under the USAP-CMA and submission of reports on them.

The Continuous Monitoring Approach consists in identifying systemic problems in aviation security and subsequent preparation and implementation of corrective actions. Shortcomings in a State's aviation security activities shall be identified by matching a State's regulatory acts with the ICAO's Standards and Recommended Practices (SARPs). The SARPs sections relating to aviation security are given in Annex 17 "Security" [5] and Annex 9 "Facilitation" [6] to the Convention on International Civil Aviation.

According to the USAP Continuous Monitoring Manual [4], the ICAO evaluates national aviation security oversight system on the base of the following documents submitted by the State:

- Protocol Questions (PQ) - the main means used within the USAP-CMA for evaluation of the level of implementation of critical elements of a national aviation security oversight system and the degree of compliance with Annex 17 standards and Annex 9 provisions by a State;

- Compliance Checklists (CC) - the means of assisting States in determining the status of implementation of Annex 17 SARPs and Annex 9 provisions and identifying any differences between national rules and practices and corresponding provisions of Annex 17 and Annex 9.

The PQ and CC are multi-page questionnaires distributed by the ICAO in the MS Office format. They shall be filled in by government officials and then sent to the ICAO for USAP-CMA audit teams to analyze the data received and give recommendations to the State on correction of identified deficiencies.

After the State fulfills the recommendations, the ICAO undertakes a follow-up audit. Hence, the audit of State's activities for better compliance with the ICAO standards is a cyclic, running and regular process.

The ICAO periodically revises Annex 17 and Annex 9 to the Convention on International Civil Aviation reviewing and updating the USAP-CMA questionnaires. Consequently, a State shall undertake to timely inform the experts on the revisions to the Annexes so that they appropriately make corrections to their answers. Experts shall also review their answers as national regulatory acts are revised.

Unlike most of the ICAO Member Countries, the Russian Federation has a multidivisional structure of aviation authorities. Aviation security competencies are shared among various agencies and organizations which complicate organization of experts interaction and makes difficult their interaction [7].

The ICAO's questionnaires may be used by a State not only within the ICAO audit but also for monitoring of its own aviation security oversight system and improvement thereof by means of preparation or revision of national regulatory acts. Efficiency of such State's activities directly depends on completeness and accuracy of the information supplied by dozens of experts. Validity and currency of such information, in its turn, depend on resolution of issues of experts' work coordination, including the implementation of mechanisms used for making consolidated decisions (if experts' opinions differ on certain issues) and experts notification of revisions in the ICAO documents and national regulatory acts.

In order to find effective ways of addressing the tasks of monitoring of the Russian aviation security oversight system as a whole and the tasks of preparing the Russian Federation to the USOP-CMA audits, it appears advisable to review the 2014 audit of the Russian Federation under the Universal Safety Oversight Audit Programme (USOAP).

Technologically and organizationally, the USOAP CMA is similar to the USOAP CMA and also based on the questionnaires and matching national regulations with the ICAO Standards and Recommended Practices. The main difference consists in the fact that the ICAO has developed an online information system [9, 10] collecting the answers to the USOAP CMA questionnaires pursuant to Resolution A37-5 [8]. Such a system was not created by the ICAO for the USAP-CMA because of the difficulty to secure submission of the national aviation security data, eventual leak of which via internet may have grave consequences. However, the USOAP CMA online system was not used for organization of Russian experts work for the reasons described below.

Hereinafter, the article analyzes in detail the problems faced by the USOAP CMA participants during preparation to the 2014 audit of the Russian Federation and suggests the ways to avoid such problems during preparation to the USAP-CMA audit of the Russian Federation pending in 2019 and the ways to enhance the efficiency of monitoring of the State aviation security oversight system.

2. PRE-2014 INTERACTION OF CMA PARTICIPANTS

Preparation to the ICAO's audit under the USOAP CMA conducted in the autumn of 2014 was supervised by a national coordinator appointed in compliance with Clause 4.3.6of the USOAP Continuous Monitoring Manual [11].

Early in the ICAO audit preparations (before July 2014), the national coordinator dealt directly with experts most of which having already filled out previous versions of PQ and CC questionnaires used by the ICAO during the 2008 audit in Russia. It was planned for each expert to fill in the questionnaire section corresponding to his competencies and e-mail or fax

them to the national coordinator who, in his turn, was to enter the expert answers in the USOAP CMA online system (Figure 1).
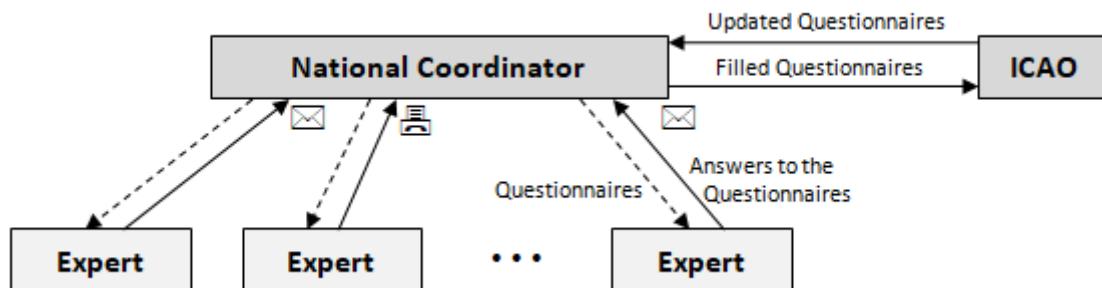
Figure 1 Scheme of pre-2014 interaction of experts and national coordinator

This interaction scheme apparently differed from the ICAO-proposed scheme that implied independent experts operation on the USOAP CMA online system; however, use of the online systemin Russia was hampered due to several objective factors:

- the ICAO system interface rendered only in English and containing a lot of acronyms, including those beyond the subject domain, unknown to experts;
- the interface very complicated, confusing, and overloaded with controls not easy to understand;
- the system lacking capability of differential access to individual questionnaire sections, which posed a serious risk of answers entered by other experts to be inadvertently deleted by a user not quite familiar with the interface;
- the online system response far from great even when accessed from the ICAO offices, which resulted in data loss when users did not wait for response from the server receiving data.

As a result, the USOAP CMA online system was used only by the national coordinator for the only purpose of transmitting filled out questionnaires to the ICAO.

Having launched the USOAP CMA online system, the ICAO began to receive completed questionnaires from States only via this system that could import questionnaires in the DOCX (Microsoft Word) formats. To implement the automatic import feature, new questionnaires were distributed via the online system in the Microsoft Word 14.0 (MS Office 2010) format that presented a document in form of edition protected template with text input fields and checkboxes.

This approach eased the load on ICAO audit team and removed ambivalent interpretation of a State's answers (for example, experts filling in a summary questionnaire often specified instead of a straight answer - the date of expected adoption of a regulation - "target is 01.07.2017, but the likely date is 01.12.2017").

The USOAP CMA online system allows downloading DOCX questionnaires automatically filled in with earlier submitted answers stored in the system data base. After download of the questionnaire, the fields of answers may be edited and the questionnaire may be uploaded back to the online system where the answers are automatically saved in the data base. As the ICAO has conceived it, the main mode of operation of the online system is filling out questionnaires via a web interface, and the multi-user operation is supported only in the web interface, while entering data via DOCX files is a secondary function not intended for multi-user operation. To avoid collisions that arise when more than one user try to edit a

DOCX file of the questionnaire at the same time, a hidden mark remembered by the system is added to the questionnaire file downloaded by the user. When the questionnaire DOCX file is imported, the system matches its mark against the most recent mark, accepting only the latest file that was exported from the system. When two users download partly filled questionnaires and having them edited try to upload them to the online system, the system accepts only the last questionnaire thus preventing from a situation where after successful receipt of answers from two users the answers of one user overwrite the answers of the other user that edited the questionnaire concurrently.

Since the data import interface via DOCX documents is essentially a single user one and its correct use is crucial for validity of data supplied on behalf of the Russian Federation, the national coordinator being responsible for the data validity did not give access to this interface to the other experts but instead collected answers from experts on his own and entered them into the online system himself.

For these reasons, the USOAP CMA online system was used in Russia only as a tool of data transmission to the ICAO and the problem of receipt and consolidation of information from Russian experts remained unresolved.

By preparations to the ICAO 2014 audit, the national coordinator already had information supplied by Russian experts for the ICAO 2008 audit, which is available in several types of documents:

- in the scans of hand-filled questionnaires;

- in the scans of printed-out documents;

- in the MS Word files of various versions;

The 2014 audit preparations highlighted the urgent need to complete and update the expert data and also to work out consolidated answers to every single question of the ICAO questionnaire.

3. DISADVANTAGES OF THE EXISTING MODEL OF INTERACTION OF CMA PARTICIPANTS

The process of transmitting the CMA information to the ICAO may be subdivided into the following stages:

1) sending the latest version of ICAO questionnaires to experts;

2) collecting current information from experts;

3) integrating experts' data for each answer and deciding on the State's official position on that issue;

4) Transmitting data to the ICAO in formats approved by the ICAO's Aviation Audit Section (ASA) and suitable for subsequent machine processing (transfer to the ICAO information systems).

Shortages of the model of interaction of the national coordinator and experts set by 2014 become apparent when these stages are analyzed in reverse order starting with the ICAO requirements to the submitted information.

The ICAO requirements of strict compliance with the format to be transmitted condition the need to store all expert data information electronically. Using printed media and scans of hand-written answers in this situation is unacceptable even at the stage of experts' data

handover because such media not only require tedious digitization and checking but also are a source of errors, including:

- loss of the answer over page part;
- assuming that the answer or its part belong to the next question due to imperfect algorithms of the OCR program incorrectly determining the order of recognition of text blocks.

The questionnaires distributed by ICAO are non-editable documents that contain forms with fill able fields that open only in MS Office 2010 and a later version. Use by experts of original forms of those questionnaires as a working tool is inconvenient because such forms do not allow for text markups essential in collaborative work to highlight the questions and answers fragments that need further handling.

The USAP-CMA Protocol Questions distributed by ICAO set forth that "The PQs may also be used by States in preparation for USAP-CMA activities and to monitor their own aviation security oversight system". But the questionnaires do not contain fields for entering lists of documents that justify actions implemented in a State and availability of regulations concerning the questions being asked. Nor the questionnaires contain fields to store notes. For the questionnaires to be used in State's domestic tasks, an additional register of supporting documents would have to be created in order to provide cross references between Protocol Questions and corresponding documents. Keep of such register would incur additional issues of its update and synchronization with the ICAO's official questionnaires as they get updated.

Not all experts, being employees of different organizations, engaged in CMA have MS Office 2010 and later versions installed at their workplaces to let them handle questionnaire templates correctly. During preparations for ICAO 2014 audits, this caused experts to use questionnaires converted to the format of previous MS Word versions. The format change has not only turned off all restrictions on document editing but also destroyed completely its internal structure precluding the subsequent automatic import into the ICAO information system. This extra capability to provide answers at one's own will has resulted in that experts occasionally checked two mutually exclusive answer options.

When ICAO amended and updated questionnaires, experts had to run an entire cross-check of questionnaires to synchronize the new ones with those that had been completed earlier. In July 2017, the analysis of the Compliance Checklist filled-out by Russian experts under the USOAP CMA revealed many inconsistencies between provisions provided by the ICAO and the answers from experts regarding their compliance. Apparently, when the old answers and new questions were collated by hand, lines with provisions added by the ICAO in the new questionnaire template were missing, causing answers to shift with regard to questions.

All shortages of the Russian model of interaction of CMA participants based on the collaborative work on the ICAO questionnaires stored in text files and their primary causes are summarized in Table 1.

Table 1 Shortages of the interaction model based on the exchange of text documents

No.	Reason	Disadvantage
1	Use of the e-mail for information exchange between experts and the coordinator	Low speed of data transfer (when the user checks e-mail not often enough).
		Non-guaranteed delivery (spam filters, full e-mail box).
		Difficulty in coordinating of questionnaires completion increasing with the number of experts engaged.
		Difficulty of ensuring the protection of documents against third party viewing (use of encryption in e-mail requires additional equipment and skills which is hard to provide to a large number of experts and coordinators from numerous organizations that handle information security differently).
2	Saving work materials as MS Office files	Possibility of data (table rows) loss due-to inadvertent edition (deletion) of a document fragment.
		Possibility of data loss as a consequence of destruction of the document structure in the event of its conversion into a bitmap image (printing → scanning → recognizing or transmitting by fax → recognizing).
		Possibility of entering ambivalent answers (checking mutually exclusive answer options).
		Difficulty in update of a document when new questions/provisions are added and old wordings are modified and, consequently, ease of making hard-to-trace errors when answers do not mach questions.
		Practical impossibility of transferring data automatically to information systems.
		Impossibility of automated analysis of information entered by experts as answers.
3	Use of original ICAO questionnaires for internal audit of the national oversight system and compliance of regulatory documents.	Lack in the ICAO questionnaires (Protocol Questions) of fields for storing references to regulatory documents of a State.
		Difficulty of synchronization between the separately kept registry of references to regulatory documents and the ICAO questionnaire being updating.

Dozens of experts with competencies in their highly specialized fields are engaged in CMA work in Russia. Generalization of experts' answers and, in case of divergence of their opinions on any question, selection of the most correct answer is a job too physically demanding for one man to handle; which is significant drawback of the interaction model comprised of only experts and a national coordinator (Fig.1).

4. WAYS TO IMPROVE INTERACTION OF USAP-CMA PARTICIPANTS

Table 1 convincingly shows that the main drawback of the existing model of interaction of the subjects working under the USOAP in Russia is caused by the use of the ICAO questionnaires in their original form (MS Office documents) as work documents and information repository.

Consequently, efficiency of continued monitoring of compliance of the ICAO standards and recommended practices with Russia's regulatory requirements may be increased by

discontinuing the use of text questionnaires as means for collecting and saving expert evaluations and by creating a work environment free of the above drawbacks.

Such work environment may be an information system (IS) based on information from the ICAO questionnaires and fulfilling the functions of:

- entering and editing data from any device connected to the internet;

- differentiation of access rights to the IS sections according to experts' competencies;

- entering and saving data linked to the questionnaires but not included in their templates (references to national regulatory acts and their full texts);

- synchronization of experts' working materials with the ICAO questionnaires being updated;

- export of accumulated expert information into the documents using ICAO templates.

Organizational problems in coordination of work of dozens of experts may be dealt with by selecting form among experts those specialists having the highest competencies within the scope of each ICAO audit and by authorizing them to check and generalize experts' answers to submit for approval by the national coordinator. In Figure 2 which illustrates a modified scheme of interaction of CMA participants, these specialists are marked as coordinators. The national coordinator may also delegate to the coordinators the tasks of notifying experts of the need to review answers following amendments to national legislation or ICAO SARPs and the tasks of supervision of experts' activities and meeting update deadlines for answers.
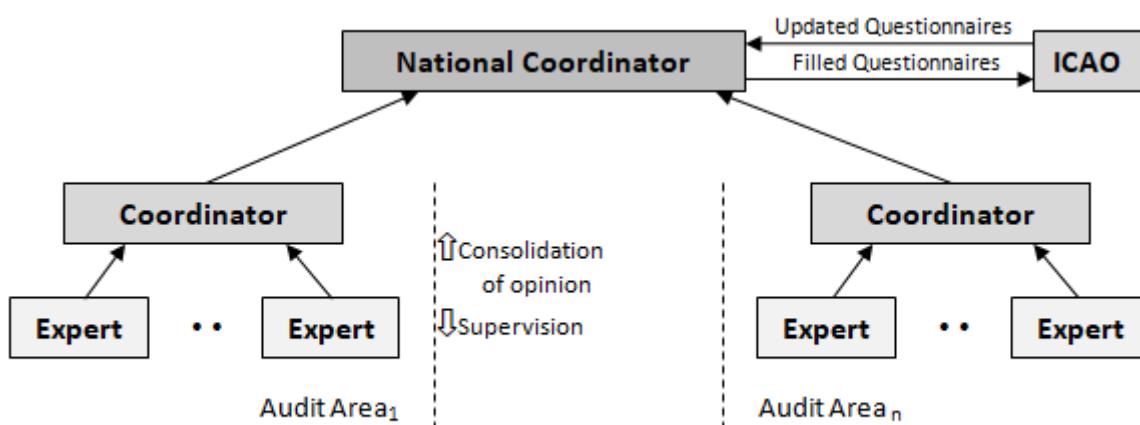
Figure 2 Modified model of interaction of CMA participants

Introduction of the IS and delegation to coordinators of part of the national coordinator functions will allow increase in the number of experts that may be involve in the USAP-CMA activities without loss of control over them by the national coordinator. A higher number of engaged experts will enhance the accuracy and validity of the information submitted to the ICAO.

5. CONCLUSION

In 2014 during preparation to the ICAO USOAP CMA audit, the Information Analyzes Center of the State Scientific Research Institute of Civil Aviation developed a System for informational monitoring of safety of aviation activities (Russian acronym SIMBAD) [12, 13] similar in architecture and operating principles to the IS proposed in this article for

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automation of the USAP-CMA operations. The SIMBAD successfully proved its efficiency by earning high marks from representatives of the ICAO review commission which allows one to assume that such system will help significantly improve performance of experts and coordinators with the USAP-CMA tasks as well.

Field of the proposed information system is not limited to objectives of preparation to the ICAO audits. Once the information system is added to with the library of national regulatory acts and the functions of tracing of regulatory acts revisions and notifying experts referring to those acts of the revisions, the proposed information system may be used to address a wider range of tasks of monitoring of the national aviation security oversight system[14, 15, 16].

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