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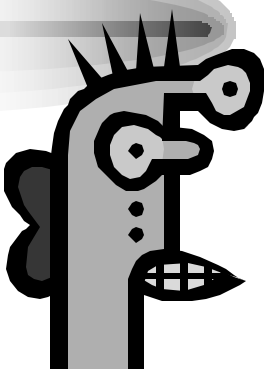
RTCA/DO-200A/EUROCAE ED-76 – not just another pretty DO-178B



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RTCA DO-200A Overview Topics

- Big Picture view
- Compliance Issues
- Document structure
- Relationship to DO-178B
- Industry Experience

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Before the DO-200A can be understood the compliance environment needs to be established. This is quite different than what most certification engineers and DERs are used to. The structure of the document was based on the compliance environment and is different than other RTCA Green Cover documents.

It is also interesting to get an industry perspective from the users of this document as to it's usefulness and any issues associated with it's implementation

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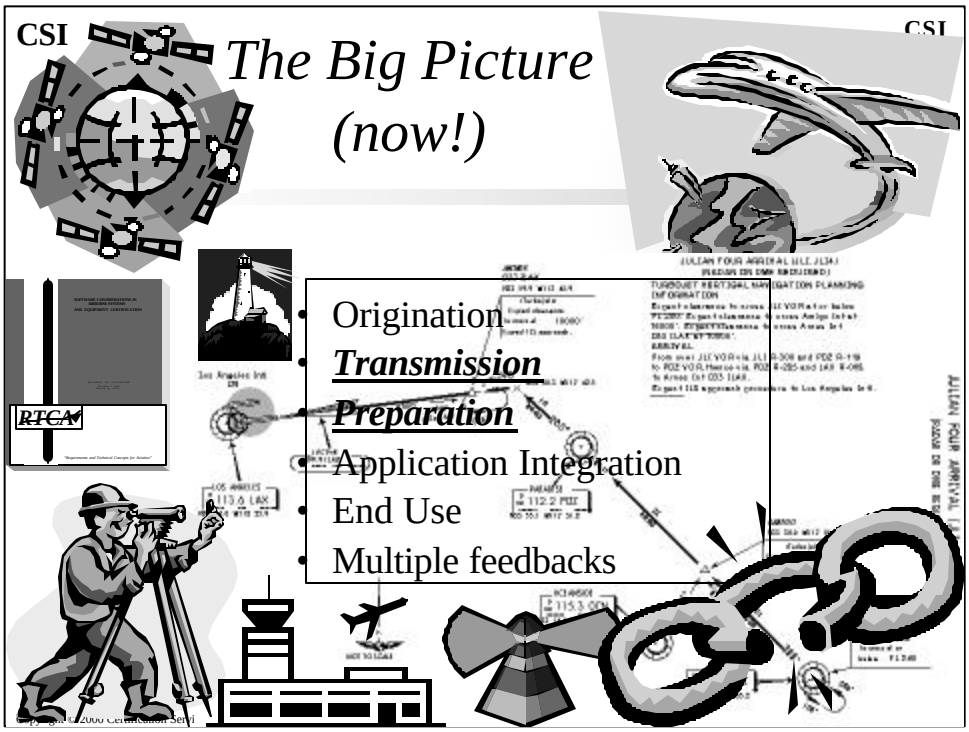

When the rubber meats the road we have some poor schmuck flying around in the clouds with anywhere from 1 to 400 other protoplasmic entities in the same airplane relying on information that is either printed on a map or a cockpit display. There is another poor schmuck directing the airplane from the ground using the another display of the same information. The issue is how do we collect all the information and transform it from raw data to something that is accurate, consistent and useable by the aviation community. It is not only the physical characteristics (existence, location, height, etc) that are important but functional characteristics as well (frequency, nav-aid type, operational data, etc.)

While there are exceptions, The ability to to this properly over time is supported by a wealth of historical evidence. However in our modern environment the raw data gets transformed and retransformed many times before reaching the user. Let's examine a typical "chain" of events

1. Origination - Surveyors are sent out to determine the lat/lon of each VOR. They write this down in paper notebooks. The installers of VORs set the frequency and beam directions as well as other characteristics. They mark this down in paper notebooks. Errors of omission and commission can occur here
2. Transmission – This raw data must then be delivered either physically or electronically to an organization or person who will need the information. Errors could be related to pages being lost, bits dropped, etc.
3. Preparation – Some organization or person will aggregate and process the received data into some form more useful for aviation. and translate to some useful and common baseline such as uniform textual descriptions, graphical representations etc. Additional errors could be introduced by this process as well. There could be many steps involved in preparation the NOAA data could be transmitted to Jeppesen who will then process the data into a format for use by an avionics supplier. The avionics supplier could then reprocess and format the data for their navigation product and place it on some sort of readable electronic or magnetic media.
4. Application Integration – Due to the changing nature of navigation, there is some continuing update cycle. The loading of the data into an actual product by the user or inserting a chart in a manual represents this phase. Some examples of errors would be loading the data base for one airplane into a different airplane or forgetting to remove a chart from a manual.
5. End-Use – This is where a pilot or ATC controller makes tactical and strategic decisions based on the actual data presented to them. Another possibility for error. This could be caused by basic human error or by a data presentation human factors error.

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Any Problems

- Mt. Erebus (1979)
- Cali
- GOAL: Provide a framework to track and reduce data errors

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While the cause of the accidents could be debated forever, in each case there was some relationship to the end use of published or transformed data.

In the Mt. Erebus accident, according to the destination coordinates the pilot had been given in his preflight briefing, they were on a safe route down the middle of ice-covered McMurdo Sound. Due to changed destination coordinates the airline's Navigation Section had inserted into the aircraft's computer, they were instead flying toward a point lying directly behind the mountain.

CALI: When the crew had to enter the name of a ground based navigational aid "ROZO" in the aircraft's flight management system (FMS, a navigation and aircraft control system) they did so by entering the letter "R". When "R" was entered, however, FMS automatically selected "ROMEO", the name of another aid at a different location and, therefore, the aircraft was steered to a different direction.

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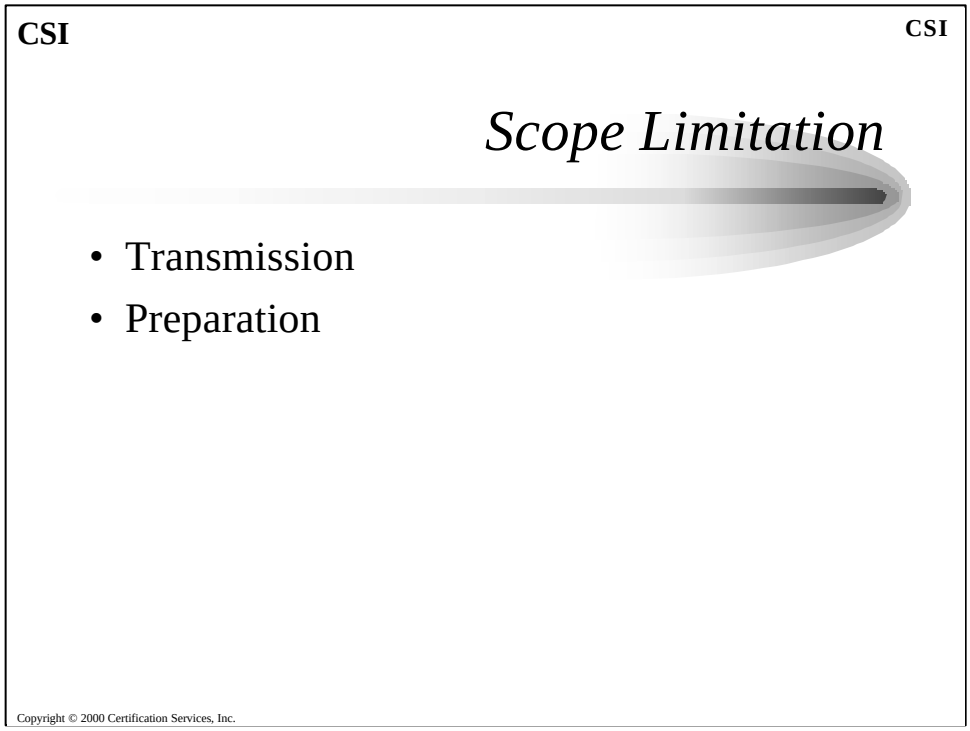

DO-200 has limited its scope to the accurate and traceable transmission of the data between oganizations and the actual preparation of the data for the end user.

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Transmission

- Receive
  - Verification of integrity
  - Validation of identity & fitness for purpose
  - Reporting requirements
- Distribute

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Following along with the overall theme, the received needs to be established as correct and usable for its purpose before any processing is done. If errors are detected there is a responsibility to report the data supplier and traced by the receiver.

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Preparation

- Components
  - Assemble
  - Translate
  - Select
  - Format
- Recording
- Applicable at multiple points in the chain

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The preparation function is broken down into the atomic components listed above. The assemble function collects all the data from participating originators (Note: originators could be some other processed data from further up the data chain, not necessarily surveyors and such). An important part of this is that the trace ability chain cannot be broken. All the necessary information must be recorded such as source, accuracy resolution to assist in future audits.

Once data is assembled it usually must be translated into some other uniform medium and format for processing for future processing.

Usually there are many subsets of the processed data prepared. This is done during the select phase wherein the subsets are determined from the assembled collection of data. Finally the data will have to be formatted for the appropriate user.

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Distribution

- Integrity checks
- Completeness checks
- Media protection

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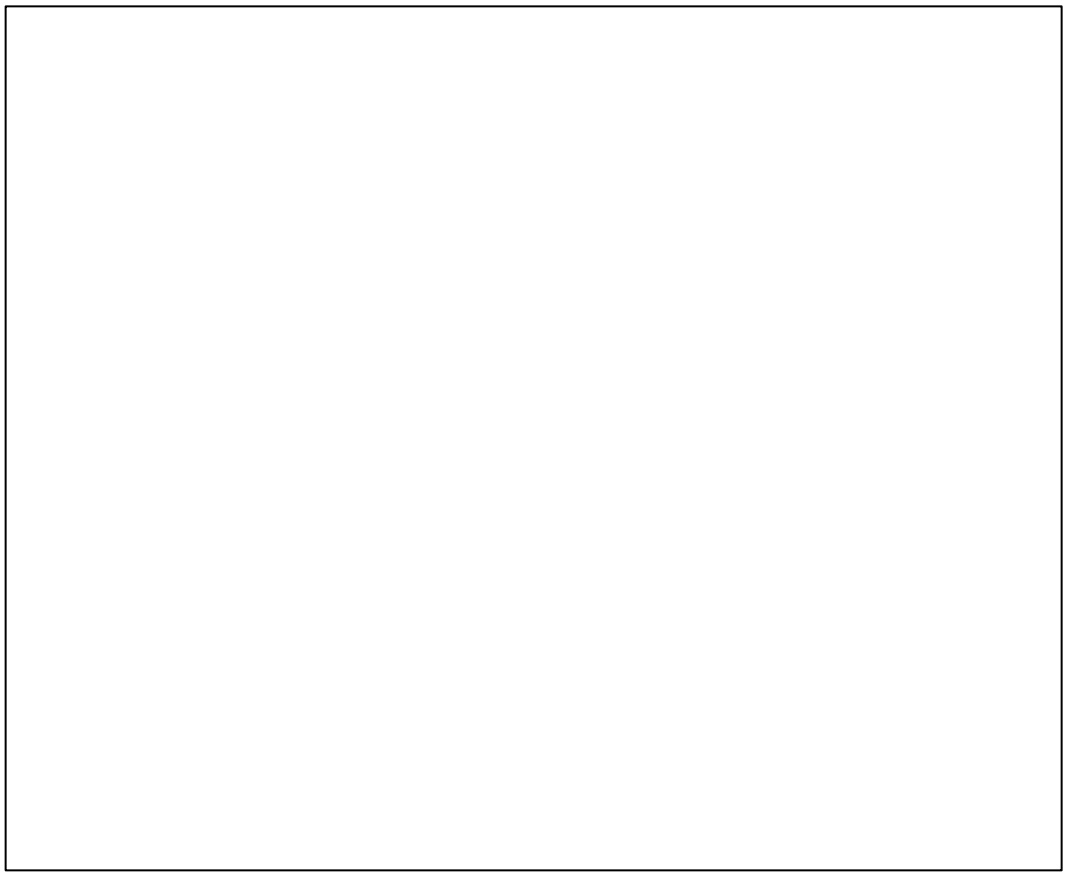

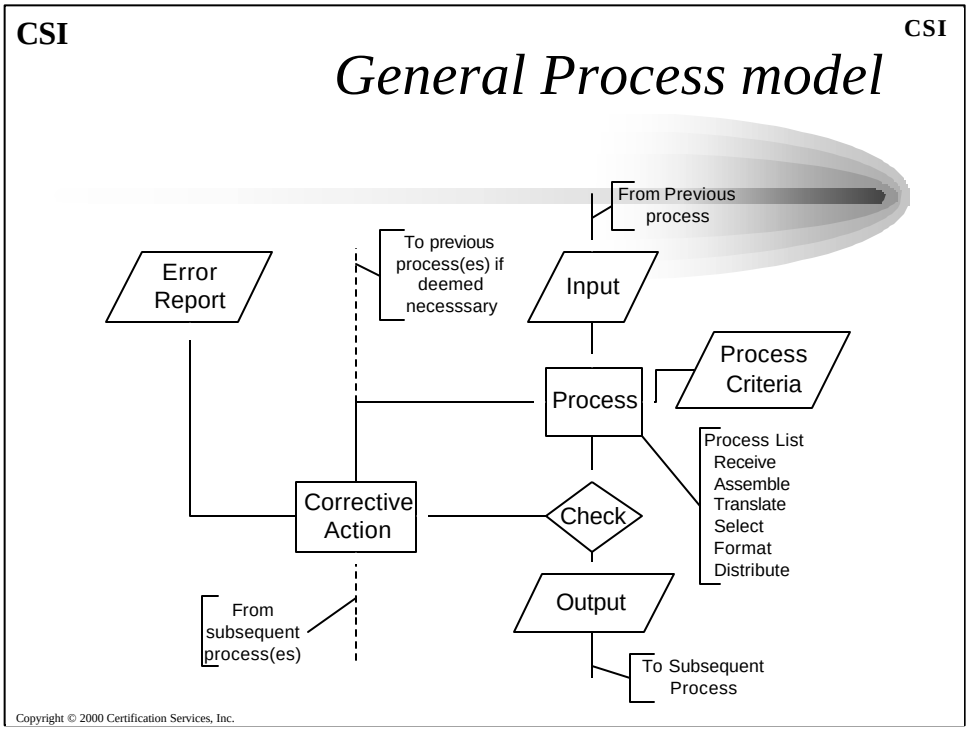

The basic process model is pretty much identical for each phase. Receive data from some previous phase and check it's validity. Process the data according to criteria for that phase, check the output of the process before being passed on to another process. If there are discrepancies determine corrective action and apply either to existing process or some previous process as needed. The output for a specific process may be in electronic form (e.g. database) or some paper form.

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Compliance plan

- Data Quality Requirements
- Aeronautical data processing requirements
- Quality management requirements
- Identification of responsibility for compliance
- Standards Used

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Data Quality Requirements

- Data Quality Characteristics
- User and Supplier perspectives
- Documentation
- Use of Appendix B

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Data quality characteristics could include accuracy, resolution, assurance level of lack of storage and transmission induced corruption, traceability to origin, timeliness, completeness to perform function, user needed format.

The user is responsible to establish the data quality requirements and ensure that they have been satisfied. The supplier is responsible for processing the data to ensure that the data quality requirements can be met.

Both the user and the supplier need to document the data quality requirements, the delivery formats, and the identification of all suppliers of data and the approval status. It is interesting that the approval of a supplier can either be by a state to whatever standards the deem necessary or proof that DO-200A is satisfied.

Appendix B has much more material on this subject.

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Aeronautical Processing requirements

- Data processing procedures
- Data Alteration negotiation with originator
- Data CM
- Skills and competencies
- Tool Qualification

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Data processing procedures involve the following: Detection of input corruption means, Assembly and storage processes, Corruption prevention for each processing stage, Required skills and competencies, Validation of data elements. Extensive requirements on documentation of tools and their verification but the exact qualification requirements beyond DO-178B's verification tool are somewhat vague and up the the processor to determine what level of rigor is require.

Quality Management

- Define criteria for evaluation
- Ensure that written procedures are being followed
- Document review records
- Use both event driven and periodic reviews
- Ensure corrective action is properly implemented

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Compliance issues, Yesterday, Today, and Tomorrow

- Yesterday
  - ICAO: States treaty based compliance with SARPS
    - Annex 15 States provide good, timely aviation data
    - Accuracy: Annex 14 airports/heliports, Annex 15 charts
    - States declare differences
    - Publish AIP and associated changes (e.g. NOTAMS AIC)
    - No Terrain Data recommendations
  - Basic data transformed by other organizations and supplied to end users – No requirements.

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The International Civil Aviation Organization(ICAO) is an international treaty based organization wherein the different states have agreed to follow the published Standards and Recommended Practices (SARPS) to ensure safe and interoperable aviation transportation. They cover everything from runway markings, navigation aids to communication protocol for data link. The aviation industry is very dependent on the accuracy of charts, textual descriptions of procedures, and data such as location and elevations. Via Annex 15, the states are requires each state that is party to ICAO to provide an Aeronautical information service to provide this data for its territory in a specified timely manner(28 day cycle; 42 day availability). This is published in an Aeronautical Information Publication (AIP). Furthermore the data needs to be accurate, at the required resolution and integrity. The accuracy is specified in Annex 11 for airports and heliports whereas the accuracy for publication and charting is in Annex 15. If a states deviates from the SARPS they must publish these as supplements so that any user can determine what the differences to the SARPS would be. There is a requirement to continually publish changes to the published aeronautical data. The actual publication (e.g. NOTAM, annex of AIP, etc.) depends on the

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Compliance issues, Yesterday, Today, and Tomorrow

- Today
  - DO-200 provides mechanism for meeting SARPS Quality criteria (goodness, timeliness, etc.)
  - Provides records to audit to determine sources of errors
  - Not directly invoked by FAA– yet
    - Intention is to have voluntary compliance
    - Certification of each data output every 28 days unfeasible
  - JAA Temporary Guidance Leaflet
  - Referenced by other standards (e.g. RNP, etc.)

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DO-200A was designed to provide the basis for meeting the "goodness" and timeliness requirements for aviation data as required by the SARPS. While a TSO is in work and an AC to recognize this information, they have not yet been published. Because data is published every 28 days in numerous different formats it is not feasible to approve each instance of the product. Therefore 200 is more of a process spec and current relies on data vendors self compliance. In some case the results of this self compliance will have to be accepted or evaluated by the FAA in conjunction with certification of systems like TAWS, RNP navigation etc.

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Compliance issues, Yesterday, Today, and Tomorrow

- Tomorrow
  - Possible AC
  - Possible Data TSO
  - More direct regulatory involvement

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Relationship to other documents

- DO-201A/ED-77
  - RNP
  - Relies on data processed IAW DO-200A
  - Maps 200A assurance levels to ICAO
- DO-236/ED-75

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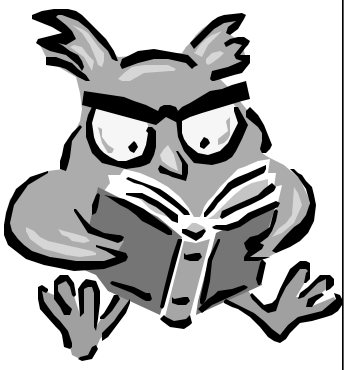
Basic Difference with DO-178B

- Voluntary vs more or less mandatory adherence.
- Lack of product attributes



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Appendix B

- How to define data quality requirements
  - Sources for establish data quality
  - Assurance Levels
  - Explanatory material for each of the characteristics.

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Summary

- Based on Aeronautical Data Chain model
- Goal – provide audit trail
- Process specification/28 day cycle
- Trust no one at each stage

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