



A322a: Understanding User Needs for Transportation Field Cabinet Systems Using ATC 5301 v02

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1. Module Description

This module is the first in a set of modules on the ATC 5301 ATC Cabinet Standard v02. It has the following recommended prerequisites in the ATC curriculum for students taking this course.

- A207a: Building an ITS Infrastructure Based on the ATC 5201 Standard Part 1 of 2
- A207b: Building an ITS Infrastructure Based on the ATC 5201 Standard Part 2 of 2
- A208: Using the ATC 5401 Application Programming Interface Standard to Leverage ITS Infrastructures
- A307a: Understanding User Needs for Advanced Transportation Controllers Based on ATC 5201 Standard v06
- A307b: Understanding Requirements for Advanced Transportation Controllers Based on ATC 5201 Standard v06

2. Introduction/Purpose

The Advanced Transportation Controller (ATC) family of standards provides an open architecture hardware and software platform that can support a wide variety of Intelligent Transportation Systems (ITS) field applications including traffic management, safety, security, and other applications. These standards are characterized by their modularity, support of multiple and current application programs, and designed to facilitate the adoption of new technologies. There are three standards within the ATC program: the ATC 5201 ATC Standard, the ATC 5401 Application Programming Interface (API) Standard, and the ATC 5301 ATC Cabinet Standard.

The focus of this module is on the recently approved ATC 5301 ATC Cabinet Standard v02. This module discusses the advantages of transportation field cabinet systems that conform to the standard. It presents the structure and key elements of the standard. It helps users identify and write user needs for ATC Cabinets which helps to justify and support an ATC Cabinet specification.

At the conclusion of this module, students will be able to:

1. Explain the advantages of transportation field cabinet systems based on the ATC 5301 Standard v02;
2. Describe the structure of the ATC 5301 Standard v02;
3. Identify and write user needs for ATC Cabinet systems; and
4. Create a concept of operations that includes ATC Cabinets.

3. Samples/Examples

Table 1. Input / Output Channels for Transportation Field Cabinet Systems.

TFCS	Physical Mounting	Internal Bus	Signal Monitor	Input Channels	Monitored Output Channels
ATC Cabinet v02	Rack and Shelf	Serial 614.4 kbps	Cabinet Monitor Unit	120	32
ITS Cabinet v01	Rack	Serial 614.4 kbps	Cabinet Monitor Unit	120	28
NEMA TS 2	Shelf	Serial 153.6 kbps	Malfunction Management Unit	64	16
Caltrans Model 33X	Rack	Parallel / Discrete Wiring	Conflict Monitor	44	16/18
NEMA TS 1	Shelf	Parallel / Discrete Wiring	Conflict Monitor	8	3/6/12/18

Table 2. Requirement traceability example from ATC 5201 Standard v02.

Verify the Requirement				
Requirement ID		Requirement Title		
5.4.3.1		Two Output Channels per HDSP120		
Requirement Text				
The HDSP120 shall have two output channels.				
Justification for the Requirement:				
1. The user needs the TFCS to support the use of output devices that have higher channel density than the commonly deployed field output devices.				
Source for Justification:				
1. UN ID 4.3.4.1				
Requirement Text (Comments/Changes)				
Guidance:				
Related Design Elements				
1. 6.2 Model 2202 High Density Switch Pack / Flasher Unit (HDSP/FU)				
Requirement Criteria		Yes		No
1	Is the justification/basis for the requirement clear and valid?	X		
2	Is the requirement well-formed?	X		
3	Is the requirement unambiguous?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test
6	If verifiable, by which method?			X
Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section above.				

Table 3. Requirement traceability example from ATC 5201 Standard v02.

Verify the Requirement					
Requirement ID	Requirement Title				
5.4.4	Low Voltage Switch Pack Modules				
Requirement Text The following power limitations shall apply to the Low Power / Low Voltage cabinet option <ul style="list-style-type: none"> - Less than 30 Volts RMS - Less than 42 Volts Peak - Less than 60 Volts DC 					
Justification for the Requirement: 1. The user needs the TFCS to provide for field wiring that is at voltage and current levels below those dangerous to humans.					
Source for Justification: 1. UN ID 4.3.4.2					
Requirement Text (Comments/Changes) Guidance:					
Related Design Elements <ol style="list-style-type: none"> 1. 6.2.2.2 Field Signal Voltage Sense Inputs 2. 6.2.4.1 Field Signal Outputs 3. 6.2.5.1.3 LV+MAINS 4. 6.2.5.1.4 LV+SIGNAL 5. 6.2.6.7.2 Flasher Channel Status Thresholds (HDFU-LV mode) 6. 6.3.5.13.1 HDFU Flasher Thresholds 7. 6.3.5.14 CMU Power Failure 8. 6.3.6.2 2212-LV Field Signal Voltage Inputs 9. 6.3.7.3 Main Contactor Secondary Status 10. 6.3.8.1 MAINS Power 11. 6.3.10.1 Power 					
Requirement Criteria		Yes		No	
1	Is the justification/basis for the requirement clear and valid?	X			
2	Is the requirement well-formed?	X			
3	Is the requirement unambiguous?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If verifiable, by which method?		X		
Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section above.					

Table 4. Requirement traceability example from ATC 5201 Standard v02.

Verify the Requirement					
Requirement ID		Requirement Title			
5.13.1		Diagnostic Display Local Display			
Requirement Text					
The TFCS shall contain a Diagnostic Display Unit (DDU) which supports local display of both historical and current cabinet status and log data collected by the monitoring subsystem.					
Justification for the Requirement:					
1. The user needs the TFCS to be of a design that reduces the time required for maintenance personnel to perform maintenance actions in the field.					
Source for Justification:					
1. UN ID 4.3.1.20					
Requirement Text (Comments/Changes)					
Guidance:					
Related Design Elements					
1. 6.5 Model 2220 Auxiliary Display Unit					
Requirement Criteria		Yes		No	
1	Is the justification/basis for the requirement clear and valid?	X			
2	Is the requirement well-formed?	X			
3	Is the requirement unambiguous?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If verifiable, by which method?			X	
Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section above.					

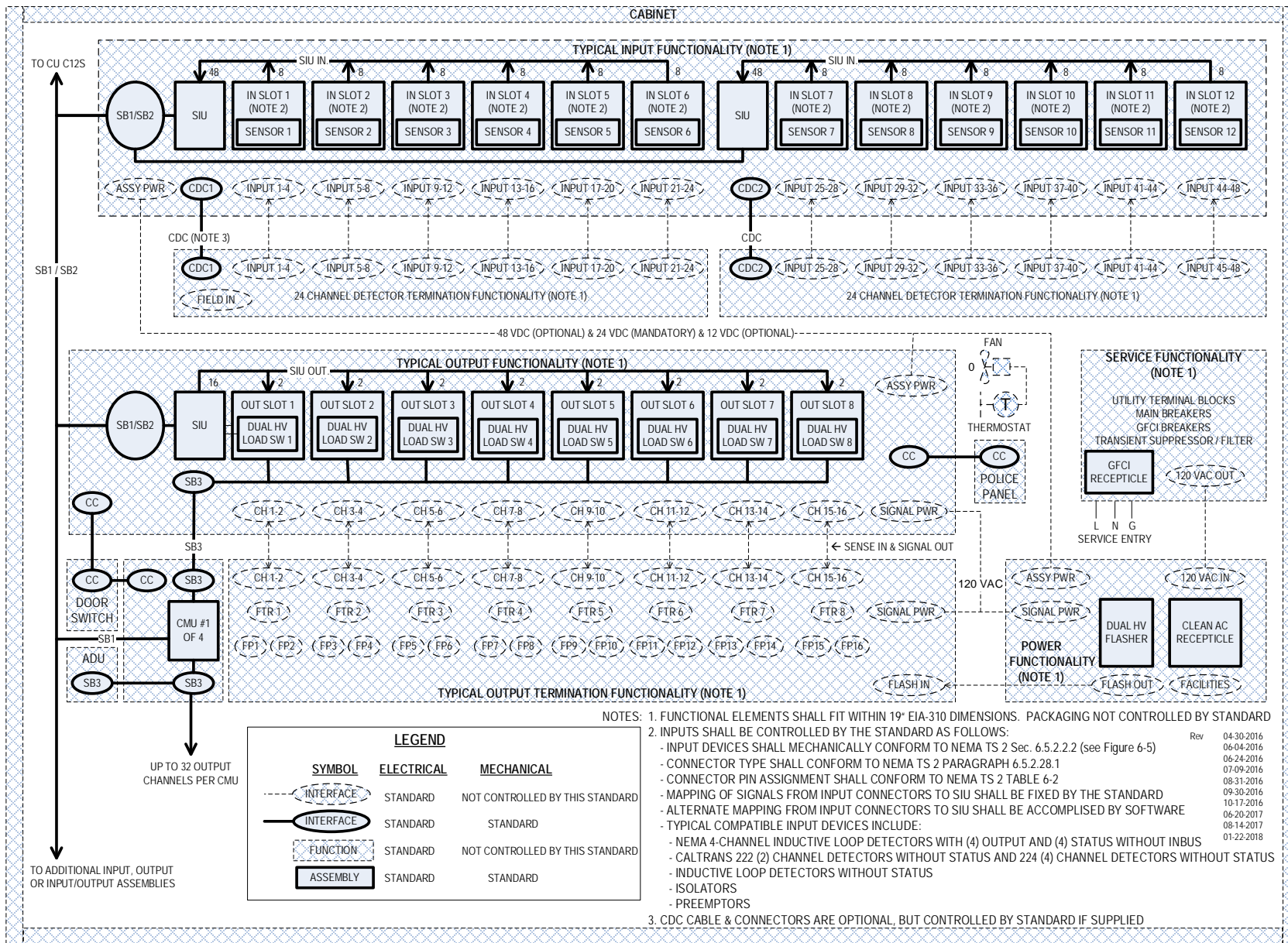


Figure 1: High Level Functional Block Diagram, High Voltage Version

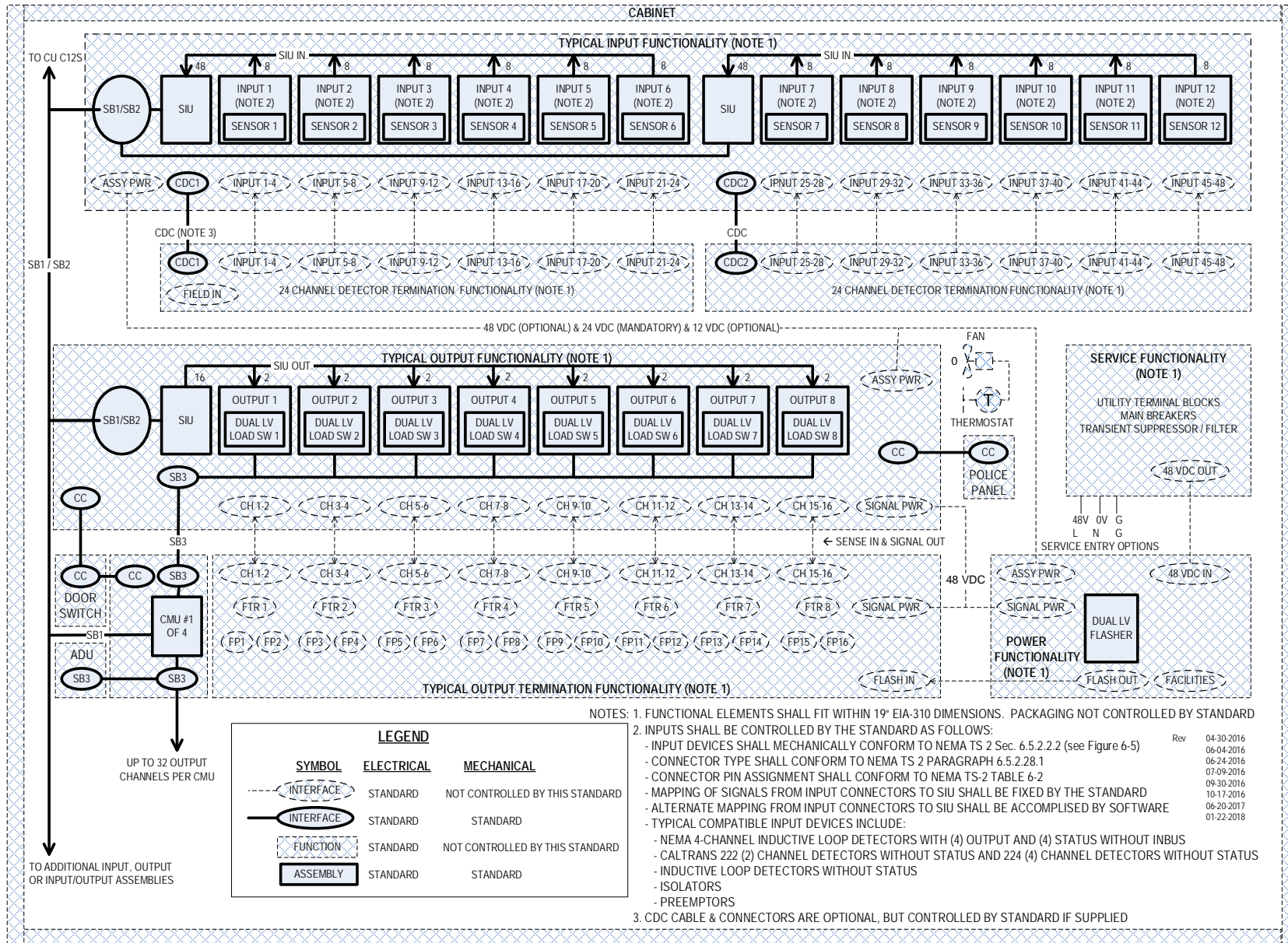


Figure 2: High Level Functional Block Diagram, Low Voltage Version

4. Reference to Other Standards

- Institute of Electrical and Electronics Engineers, *IEEE 29148-2018 - ISO/IEC/IEEE International Standard - Systems and software engineering -- Life cycle processes --Requirements engineering*. IEEE, 2018.
<https://standards.ieee.org/standard/29148-2018.html>
- Institute of Transportation Engineers, *ATC 5201 Advanced Transportation Controller (ATC) Standard Version 06.25*. ATC Joint Committee, Recommended Standard, January 12, 2018.
<https://www.ite.org/technical-resources/standards/>
- Institute of Transportation Engineers, *Recommended Standard ATC 5201 Advanced Transportation Controller (ATC) Standard Version 06A*. ATC Joint Committee, Recommended Standard, January 2020.
<https://www.ite.org/technical-resources/standards/atc-controller/version-6/>
- Institute of Transportation Engineers, *ATC 5301 Advanced Transportation Controller (ATC) Cabinet Standard Version 02*. ATC Joint Committee, March 18, 2019.
<https://www.ite.org/technical-resources/standards/its-cabinet/version-2/>
- Institute of Transportation Engineers, *ATC 5401 Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC) v02.17*. ATC Joint Committee, September 15, 2013. (Note same as September 1, 2011.)
<https://www.ite.org/technical-resources/standards/atc-api/>
- Institute of Transportation Engineers, *Recommended Standard ATC 5401 Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC) v02A*. ATC Joint Committee, January 2020.
- Institute of Transportation Engineers, *Intelligent Transportation System (ITS) Standard Specification for Roadside Cabinets v01.02.17b*. ATC Joint Committee, 16 November 2006.
<https://www.ite.org/technical-resources/standards/its-cabinet/version-1-02-17b/>
- National Electrical Manufacturers Association, *NEMA Standards Publication TS 1-1989 Traffic Control Systems*. NEMA, 1989.
- National Electrical Manufacturers Association, *NEMA TS 2-2016 Traffic Controller Assemblies with NTCIP Requirements Version 03.07*. NEMA, 2016

5. Glossary

To include additional **descriptions/acronyms** used primarily in the module.
List out in alphabetical order.

Term	Definition
AASHTO	American Association of State Highway and Transportation Officials
AC	alternating current
ATC	Advanced Transportation Controller
ATCC	ATC Cabinet
CB	Circuit Breaker
CBD	Central Business District
ConOps	Concept of Operations
DC	direct current
EMI	electromagnetic interference
ESD	Electrostatic Discharge

Term	Definition
FHWA	Federal Highway Administration
GFI	Ground Fault Interrupt
I/F	interface
I/O	input/output
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMSA	International Municipal Signal Association
IPC	Formerly, the Institute for Printed Circuits. This same institution was later called the Institute Interconnecting and Packaging Electronic Circuits. It is now referred to as IPC-Association Connecting Electronics Industries.
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
JPO	Joint Program Office
LED	light emitting diode
MTBF	mean time between failures
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Lab
NTCIP	National Transportation Communications for ITS Protocol
PF	power factor
RFI	radio frequency interference
SDO	Standard Development Organization
SEMP	System Engineering Management Plan
SEP	Systems Engineering Process
SSC	Small-Sized Cabinet
StdHLD	Standards High Level Design
StdRS	Standards Requirements Specification
TFCS	transportation field cabinet system
UPS	Uninterruptible Power Source
USA	United States of America
USDOT	United States Department of Transportation
VAC	voltage alternating current
VDC	voltage direct current
WG	Working Group

6. References

- California Department of Transportation, *Caltrans Transportation Electrical Equipment Specifications (TEES)*. California Department of Transportation, 12 March 2009. <http://www.dot.ca.gov/trafficops/tech/docs/TEES2009.pdf>
- Institute of Transportation Engineers, *ITS Cabinet V2 Standards Requirements Specification (StdRS) v01.04*. ATC Joint Committee, 31 January 2019. <https://www.ite.org/technical-resources/standards/its-cabinet/version-2/>

7. Study Questions

The quiz/poll questions and answer choices as presented in the PowerPoint slide to allow students to either follow along with the recording or refer to the quiz at a later date in the supplement.

1. Which of the following is NOT a benefit of using the ATC Cabinet Standard?
 - a) Low voltage option for 48 VDC on field wires
 - b) Touch Safe Design
 - c) Functional standard except where interchangeability desired
 - d) Same number of channels per switch pack as ITS Cabinet v01

2. True or False? The High Level Functional Block Diagram identifies how the ATC Cabinet functions perform actuated signal control.
 - a) True
 - b) False

3. Which of the following is a correct statement?
 - a) Rationale of user needs have proposed solutions
 - b) User needs must testable
 - c) A user need is a major desired capability
 - d) Only needs in ATC 5301 v02 are valid for a spec

4. Which of the following is a benefit of building a ConOps for an ATC Cabinet?
 - a) Provides justification for investment in ATC Cabinets
 - b) Only technical stakeholders are necessary to produce it
 - c) Strategic or regional plans are unnecessary
 - d) Organization of user needs is the same for all agencies