Background of environmental testing standard "ISO-19683"
- From Small satellite to Lean satellite and Key for mass-production -

Hirokazu Masui and Mengu Cho
Kyushu Institute of Technology
Once upon a time (not long ago)...

Hodoyoshi project (ほどよしプロジェクト) started 2010.

Development of Microsat (50 kg class)
Component Bender
Finding new user
Testing method

Procyon by Tokyo University
IDEA and ELSA by Astrocale
CESAT-1 by parent company
“Hodoyoshi” = Reasonable reliability

Reliability ↔ Development

Conventional development method

Increasing cost!!
Reasonably Reliable SE

Performance-cost Curve

Actual reliability = Designed reliability \times Probability that the system can behave as designed

- Modeling of various expertise and experiential knowledge
- Design methodology
- Application to different areas

Cost Explosion:
Complicated dual/triple redundancy, additional paperwork, additional tests, additional human resource, expensive space-rated parts, etc.

Nano-satellite design point

Rather flat area where performance improvement can be achieved without much additional cost/workload

Governmental satellites

Design point

less interfaces, proven technology

standardization/process innovation

Performance/reliability

Cost/workload
“Hodoyoshi” = Reasonable reliability

Reliability ↔ Development

Conventional development method

→ Suitable development method for Smallsat

Reliability ↔ Testing

Conventional testing method

→ Suitable testing method for Smallsat
CeNT can provide all environmental tests except for radiation test for less than 50kg satellite
Satellite parts on web shop

One stop solution for Cubesat and SmallSat
It’s time to buy the satellite components from Web shop!!
On-line shop ...

When you buy something from Amazon

What is the most important thing for customer?
PC shop on Web

If a cheap purchased item break soon, most of people will be convinced.
Satellite parts on web shop

If a purchased satellite component did not work, Can you convince that the purchased parts of the satellite were cheap?

“NO”

Because...
No Replace
No Repair
And
It’s not cheap for small team
What is the important thing for purchasing satellite components?

However, How do we qualify the components?
Necessity of standard

Customer ↔ Provider

Standard about test level and condition is necessary

Making consensus
Accelerate trade
What is “ISO-19683”?  

ISO-19683  
“Space systems – Design qualification and acceptance tests of small spacecraft and units”  

This provides test methods and test requirements for design qualification and/or acceptance of small spacecraft or units. It provides the minimum test requirements and test methods to qualify the design and manufacturing methods of commercial small spacecraft and their units and to accept the final products.
Making of “ISO-19683”

NASA, JAXA and ESA testing standard

→ Review and Pick up points

We tested many small satellites in our facility and corrected test data

We held many workshop and discussed the contents of standard
Detail of ISO-19683

Vibration

Thermal vacuum

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range</td>
<td>-15°C to +50°C</td>
</tr>
<tr>
<td>Number of cycles</td>
<td>2 or more</td>
</tr>
<tr>
<td>Operational soak duration</td>
<td>1 hour or longer</td>
</tr>
<tr>
<td>Thermal dwell</td>
<td>1 hour or longer</td>
</tr>
</tbody>
</table>

Please buy from ISO web
Definition of “Small”

A question from a participant was “What is the definition of “Small”?

One of conclusion was “We don’t want to develop a small satellite at the first”
“As a result of cost saving and fast delivery, size of satellite becomes small”

The suggested word was “Lean Satellite”
“Lean Satellite”

Using COTS parts
Low Cost
Fast Delivery

Next Lean Satellite Workshop:
The end of 2019 or the begging of 2020
Lean production

Word of “Lean” originates from Lean production.

Lean production was developed and studied by MIT researchers. They studied Kaizen (改善) and Kanban (看板) by Toyota.

http://www.lean.org/Common/LexiconTerm.cfm?TermId=353
Arrival of mass production

New technology and knowledge for AIT

Tasks for mass-production of Lean satellite (>1000 sats)

To achieve short delivery
Integration ➔ Simplified interface
Safety review ➔ Minimize document work
To save cost
Vibration test ➔ Shorten time of vibration test
Functional test ➔ Shorten time of functional test

So far
One make
Exp: Universities

Now
100 satellite
Example: Planet lab

Near Future
1000 satellite
Example: One Web Space X
Conclusion

Introduction of Background of ISO-19683

Suggestion of word “Lean satellite”

For mass production of lean satellite, we need to find the solution
We appreciate the efforts and contributions of many participants on the establishment of standards.
Especially, Dr. Graziani Filippo and Prof. Jordi Puig-Suari

Thank you for listening!!
ご静聴ありがとうございました．