plastron
space for the next generation

esa
business incubation centre UK

Risk Mitigation in Cubesat Production

14th December 2023

International *'Low Earth Orbit'* **Cube and Small Satellite Conference & Seminar**
Ankara, Turkey

+44 7383 998939
charlie@plastron.uk

Who we are

Charlie Young
Plastron UK

Based at Harwell Technology Park

Upstream Supply-Chain Engineering Safety & Transformation

- Hazardous processing experts
- Facility Design
- Workforce skills development
- Safety advisory
- Supply-chain development
- Safety Risk Management

Over 40 years combined experience in commercial launch operations for ESA, CNES, Airbus, OHB and Thales

Professional experience

- Comsat propulsion engineering
- Ariane/CNES launch operations
- High-risk service design and Product design

Dr M.K.S. Al-Mhdawi
Teesside University

Dr. Al-Mhdawi

- Assistant Professor in Engineering Project Management at the School of Computing, Engineering, and Digital Technologies (SCEDT), Teesside University, UK.
- Ph.D. in Risk Management from the University of Southampton.

Research focus

- Modelling risk behaviour
- Mathematical models for risk quantification in engineering production and manufacturing
- Special interest in risk decision support system models
- Hazard recognition
- Quantitative methods, such as Fuzzy Sets Theory

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Space Engineering Fails

In an ideal world, space hardware will function **perfectly** and **outlive** its design life. In the rare instance of a failure, **responsive** technologies deliver, install and commission replacement parts; missions are **never** lost.

However…

Failure of an entire mission is a **known** risk.

To quantify and qualify this risk, each **subsystem**, down to individual **components**, must be understood.

Three things we know

Risks are open to **bias**, (eg: prior experience)

Risks can be treated **incorrectly**

Risks are mitigated through **standards**

Cubesats – affordable, but at times, unpredictable

Half of All First-Time CubeSat Projects End in Failure

2014

Half of all first-time Cubesat projects end in failure. And that's not entirely bad.

Mark Betancourt

September 18, 2014

CubeSats have been like most new systems, with significant "infant mortality". According to a paper presented at the 30th Annual AIAA/USU Conference on Small Satellites, about 33 percent of the "DOA" (dead on arrival) satellites have unknown failure causes.[1]

November, 2017

2017

More than half of the cubesats launched on Artemis 1, though, suffered problems after launch that, at a minimum, jeopardized their missions. The problems affected cubesats built by both space agencies and startups, and had little technically in common.

February, 2023

2023

The root causes can be found system-wide

- Engineering experience
- Testing regimes
- Process & workflow
- Use of parts
- Launch exposure resilience
- Mission exposure resilience
- GSE
- Hardware handling

Cubesat Safety Risk Management Platform Proposition

Risk identification	Singular	Compound
Technology causes		
Process & workflow causes		
Human-based causes		

A **digital** tool to **evaluate** and **quantify** sources of **risk** for CubeSat **hardware development** & **mission delivery.** With **best practice** guidance available to **manage** and **resolve** them.

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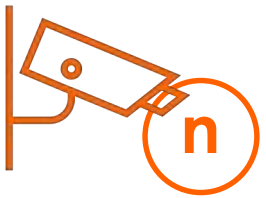
The Experience of the User

Identification → Quantification → Response → Monitoring

Risk identification analysis

Risk measurement and prioritisation

Personalised best practice response guidance



Risk tracking dashboard

Product Workflow

Section 1: About the Organisation

What business life stage are you?	Non, business: University
How much space hardware production experience do you have?	3 - 5 years

Section 2

Product Workflow

Section 2: About the People

Technical Skills	CAD, Test Design, Analysis, *Highlight all acquired skills in the list*
Commercial Skills	Business plans, Budgeting, *Highlight all acquired skills in the list*
Operations Skills	Project management, Resourcing, *Highlight all acquired skills in the list*

Section 3

Product Workflow

Section 3: About the Project

What is the purpose	Fix a design error	
TRL Levels	TRL 5	TRL 8
Confidence in the project plan	Prepared	70%
Confidence in the budget	Completed	100% available

Section 4

Product Workflow

Section 4: About the Hardware

What is the intended outcome?	An updated commercial product	
What is the product classification?	Propulsion	Regulator
Risk system boundary	Entire sub-assembly, isolated	
Application context and life	LEO	2 – 5 years

Section 5

Product Workflow

Section 5: About Best Practice

What is your space standards competency level?	I know which ones to assess
How many years experience?	2
What is your test design & delivery competency level?	I do not have any experience
How many years experience?	0

Analysis

Product Workflow

High Level Analysis

Section 1: About the Organisation	30%	Detail
Section 2: About the People	50%	Detail
Section 3: About the Project	42%	Detail
Section 4: About the Hardware	68%	Detail
Section 5: About Best Practice	89%	Detail

Product Workflow

Section 2: About the People

Combined Risk Level	50%
Technical skills	42%
Commercial skills	76%
Operations skills	32%

\+ **Technical skills**

\- **Commercial skills**

Open each section to identify mitigation guidance to apply

Developing business plans +

Sourcing expert business advice +

Commercial mentors -

Mentors can be sourced through your regional space cluster. Rates vary, but can be negotiated. Here are some links with further information.

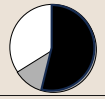
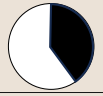
Commit

\+ **Operations skills**

Product Workflow

Risk Response Dashboard

Section 1 | Section 2 | Section 3 | Section 4 | Section 5

ID	Risk	Response	Status	Current Risk	Target Risk
1.01	Technical skills – lack of experience in designing test plans.	Source professional mentor Training in test design	Closed Open		

Thank You

Easily identify: By considering the potential causes systemically

Automatically quantify: By using predefined models to give each risk a value

Seamlessly advise: By linking each risk to high-quality mitigation guidance

Dynamically monitor: By using mitigation feedback to re-evaluate risks

LINKEDIN

charlie young

Joint Managing Director (Design)

Charlie@plastron.uk

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