

# 1st Accelerators Technology Sector Workshop

Engineering Design Tools and Processes  
Project Management Methodologies and Tools

Chair: Mike Lamont

Interconnecting knowledge, experience, methods,  
people & data to foster learning & collaboration



ATS  
Accelerators and  
Technology Sector

# Tracking budget, procurement, and risk for High Luminosity LHC

---

Irene Crespo Garrido

## References:

B. Delille & S. Riebe – Jan 2020

H. Garcia Gavela, V. Guillen Humbria & G. Prica – Nov 2023

G. Vandoni – June 2024



ATS

Accelerators and  
Technology Sector



# Outline

- ❖ Project challenges
- ❖ EVM in the context of the project
- ❖ EVM implementation and change process
- ❖ EVM for problem anticipation
- ❖ Conclusion

## References:

B. Delille & S. Riebe – Jan 2020

H. Garcia Gavela, V. Guillen Humbria & G. Prica – Nov 2023

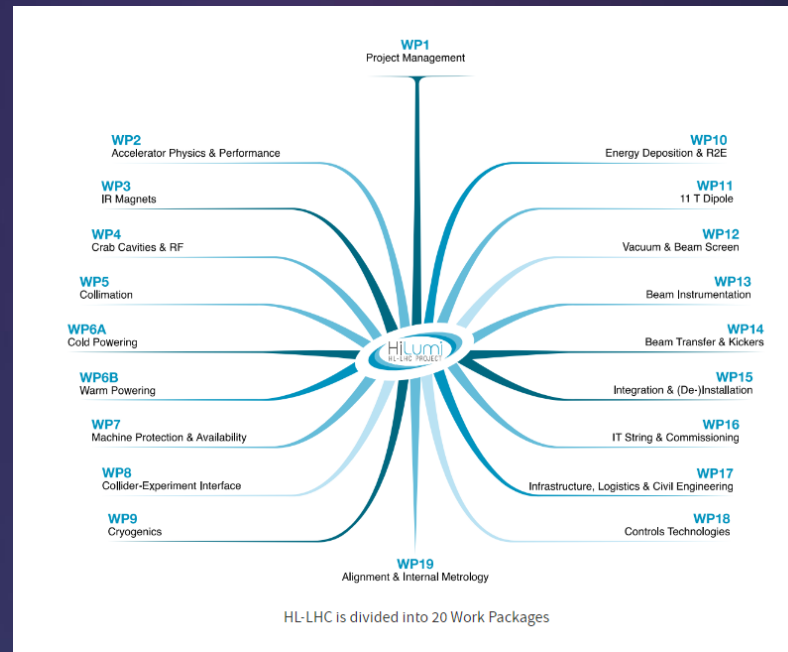
G. Vandoni – June 2024



# Project Challenges



**1 billion LHC major upgrade project, composed of 20 WPs covering cutting-edge technologies and major infrastructure works.**



**WP responsibilities:**

- Manage the technical issues and decisions
- Manage the schedule of the WP
- Manage the budget of the WP
- Report to the Project
- Announce overcosts, savings...

**A work package is a group of related tasks within a Project**

**IMPORTANT:** Not to be confused with the CERN group or section.

# HL-LHC Funding Sources

The costs of the project are distributed between:

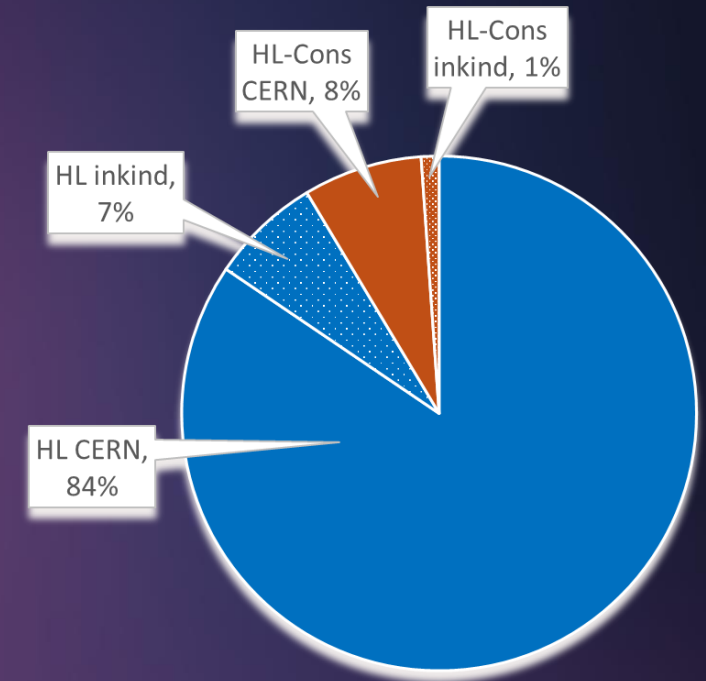
	HL	HL-Cons	Total
<b>CERN</b>	<b>973.7</b>	<b>86.2</b>	<b>1059.9</b>
<b>In-kind</b>	<b>80.0</b>	<b>12.9</b>	<b>92.9</b>
	<b>1053.7</b>	<b>99.1</b>	

- ❖ **HL-LHC Project:** From studies to deliverables to be installed in LHC tunnel or HL-LHC galleries.
  - Included: goods and labor (industrial service, students, fellows, and associates).
  - Excluded: CERN staff cost, price indexation, and contingency for risks.
- ❖ **HL-CONS Project:** Spares, R2E, some consolidation activities

## Funding sources

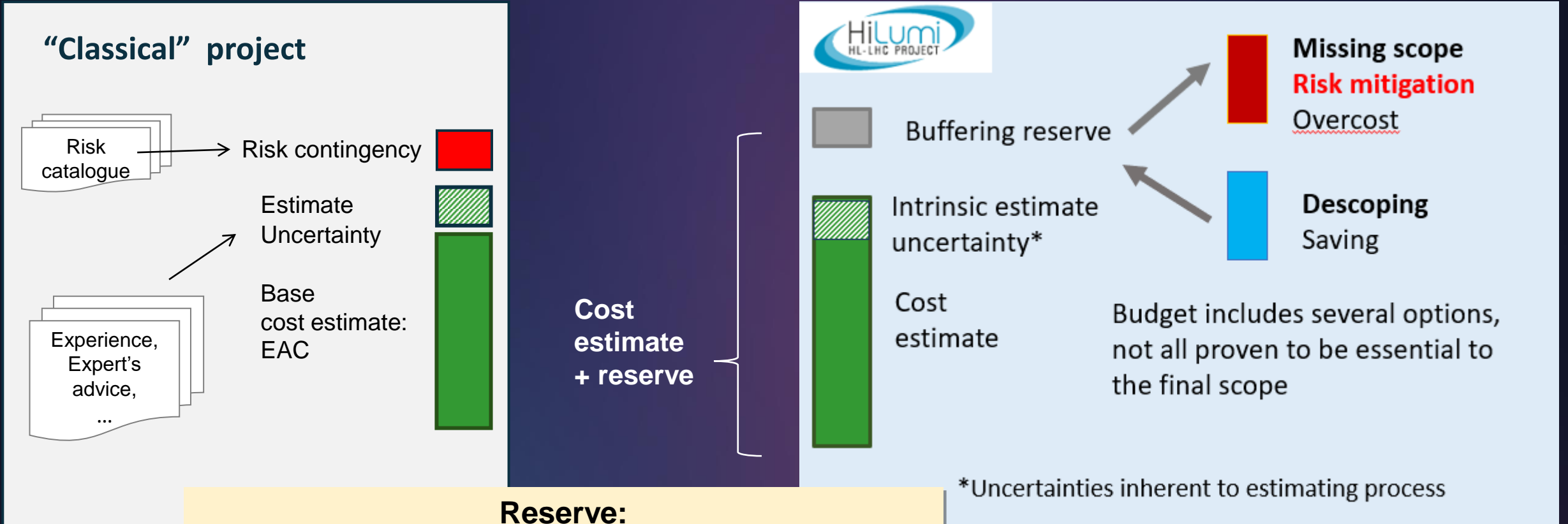


**IN-KIND**



**IMPOSSIBLE TO MANAGE WITHOUT THE USE OF EVM!!!!**

# UNCERTAINTY, RISK & CONTINGENCY



**Reserve:**  
Initially zero, it increases by descoping of initially included options & savings, decreases by added costs  
Dynamical transfer from/to Project to/from WPs



# EVM in the Context of the Project



# What is EVM

**EVM is a management methodology for integrating scope, schedule, and resources (material and personnel). The baseline is used to measure project performance and progress and forecast the project outcome.**



- ❖ Aids management in the preparation of:
  - Revised budget
  - Annual progress report
  - Draft & final budget
  - Medium term plan
  - Cost and schedule reviews



Am I spending more than I expected?

$$CV = EV - AC$$

$EV < AC$	$EV = AC$	$EV > AC$
(-) CV	(0) CV	(+) CV
Over	On	Under



Am I on schedule?

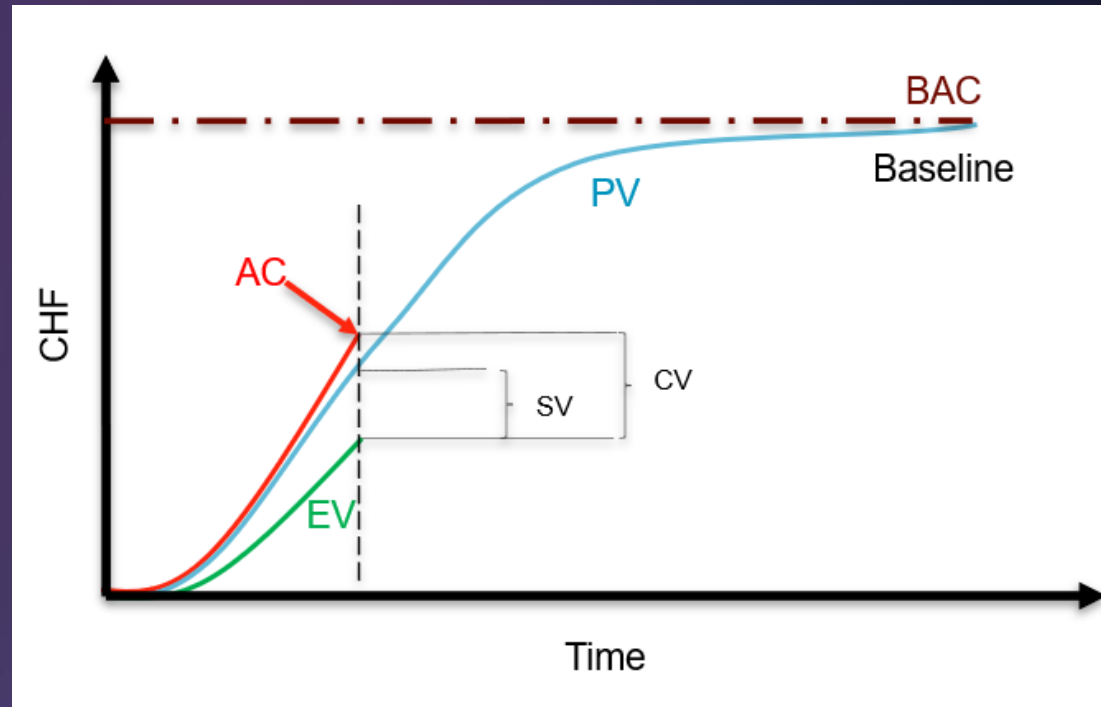
$$SV = EV - PV$$

$EV < PV$	$EV = PV$	$EV > PV$
(-) SV	(0) SV	(+) SV
Behind	On	Ahead

**PV** = Budget baseline  
 distributed over time.

**EV** = Value of the work  
 accomplished up to a  
 specific point in time.

**AC** = Costs incurred in  
 completing the work up  
 to a specific point in  
 time





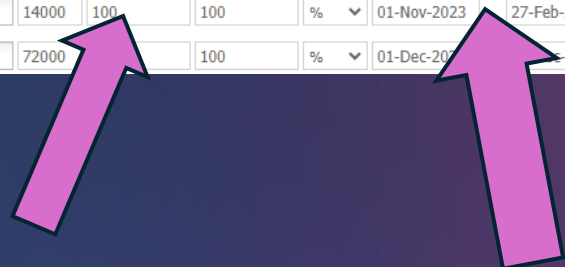
# EVM implementation and change process

# Implementation of EVM for the HL-LHC project

- ❖ EVM is implemented in the project by creating Work Units (WUs).
- ❖ We attempt to structure the workunits closely to project engineers' activities, making EVM easier to understand concerning their work and making reporting more straightforward.

## Report progress in WU!!!

Description	Budget	Actual	Weight	Unit	Start	Finish
HL-LHC [14 kA; 08 V] Series: Frame - Busbar kit	225000	0	8	U	01-Jan-2024	01-Jun-2024
HL-LHC [14 kA; 08 V] Series: Frame - Cables	68000	0	100	%	01-Nov-2023	01-Aug-2024
HL-LHC [14 kA; 08 V] Series: Frame - High current sockets	14000	100	100	%	01-Nov-2023	27-Feb-2024
HL-LHC [14 kA; 08 V] Series: Frame - Water distribution elements	72000		100	%	01-Dec-2023	31-May-2024



Edit Workunit 250329

General Summary Revised Estimates Notes Data Quality History EVM Contracts

You can only modify its non-EVM content using this form or report progress by doing click on Report Progress button.

Baseline	Status*	Description*	WBS*	Holder*	Type*	Start Date*	Finish Date*	Comments
Baseline 7.6	AC	HL-LHC-WP6B-2-14KA - Series converters - frames	HLLHC 6B.2	Y. Thurel	Normal	01-Jul-2023	31-May-2026	

MATERIAL RESOURCES	Description*	BC	RBC	Org Unit	Amount*	Currency*	Start	Finish	Comments
GOODS	Budget	92751			958,000	CHF			

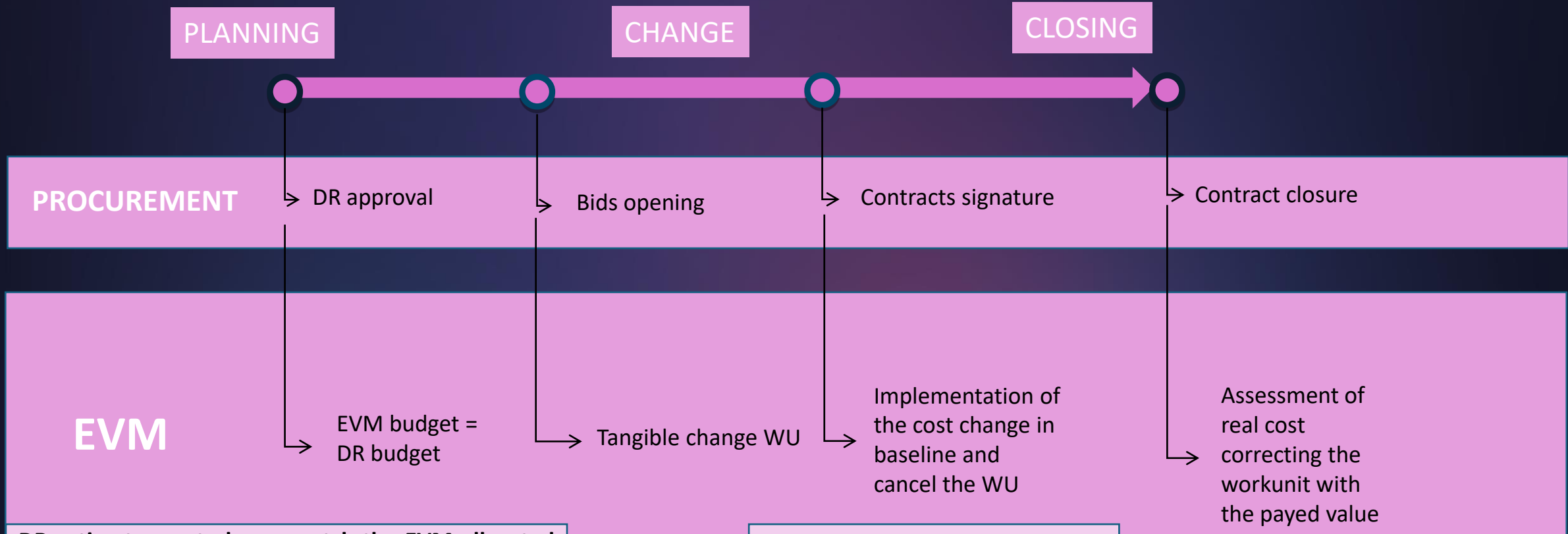
  

DELIVERABLES	Description*	Weight*	Actual quantity*	Total quantity*	Unit*	Start	Finish	Comments
HL-LHC [14 kA; 08 V] Series: Frame - Raw frames		200000	0	8	U	01-Jan-2024	30-Jun-2025	
HL-LHC [14 kA; 08 V] Series: Frame - Busbar kit		225000	0	8	U	01-Jan-2024	01-Jun-2024	
HL-LHC [14 kA; 08 V] Series: Frame - Cables		68000	0	100	%	01-Nov-2023	01-Aug-2024	
HL-LHC [14 kA; 08 V] Series: Frame - High current sockets		14000	100	100	%	01-Nov-2023	27-Feb-2024	Ordered / DAI 993885
HL-LHC [14 kA; 08 V] Series: Frame - Water distribution elements		72000	28	100	%	01-Dec-2023	31-Dec-2024	
HL-LHC [14 kA; 08 V] Series: Frame - Elettas		96000	100	100	%	01-Nov-2023	27-Feb-2024	Single source DAI
HL-LHC [14 kA; 08 V] Series: Frame - Flexibles		69500	0	100	%	01-Dec-2023	01-May-2024	Clone DO
HL-LHC [14 kA; 08 V] Series: Frame - EMC cards		13000	0	100	%	01-Nov-2023	01-Mar-2024	
HL-LHC [14 kA; 08 V] Series: Frame - FWD		48000	4	100	%	01-Jul-2023	31-May-2024	Single source DAI
HL-LHC [14 kA; 08 V] Series: Frame - Protection module		16000	56	100	%	01-Jul-2023	31-Dec-2024	
HL-LHC [14 kA; 08 V] Series: Frame - Electrical boxes		54500	20	100	%	01-Jul-2023	31-Dec-2024	
HL-LHC [14 kA; 08 V] Series: Frame - Manpower for assembly		82000	0	100	%	01-Jun-2024	31-May-2026	Including possible need

EXTERNAL LINKS	Type*	Id*	Description	Open
DAI		9882996	HL-LHC 14KA series : FWD 3rd path diodes	Open
DAI		9892253	HL-LHC 14KA series : FWD 3rd path clamp	Open
MAG		9904817	HL-LHC 14KA series : FWD 2nd path diodes	Open
MAG		9913094	HL-LHC 14KA series : AC/DC Aux - sub	Open

# EVM implementation and change process - Example



**DR estimate must always match the EVM allocated budget** unless specifically agreed with MCO and PO

For each DR, there is one or more WUs uniquely dedicated to cover it – The name of WUs contains the DR number

**Tangible WU** is used to earmark future cost changes. Not in the baseline.

# EVM for problem anticipation

*M. Rodriguez Perez: "Anticipating problems costs less than reacting to them."*

One technical engineer or engineer can spend up to 200-220kCHF/ year

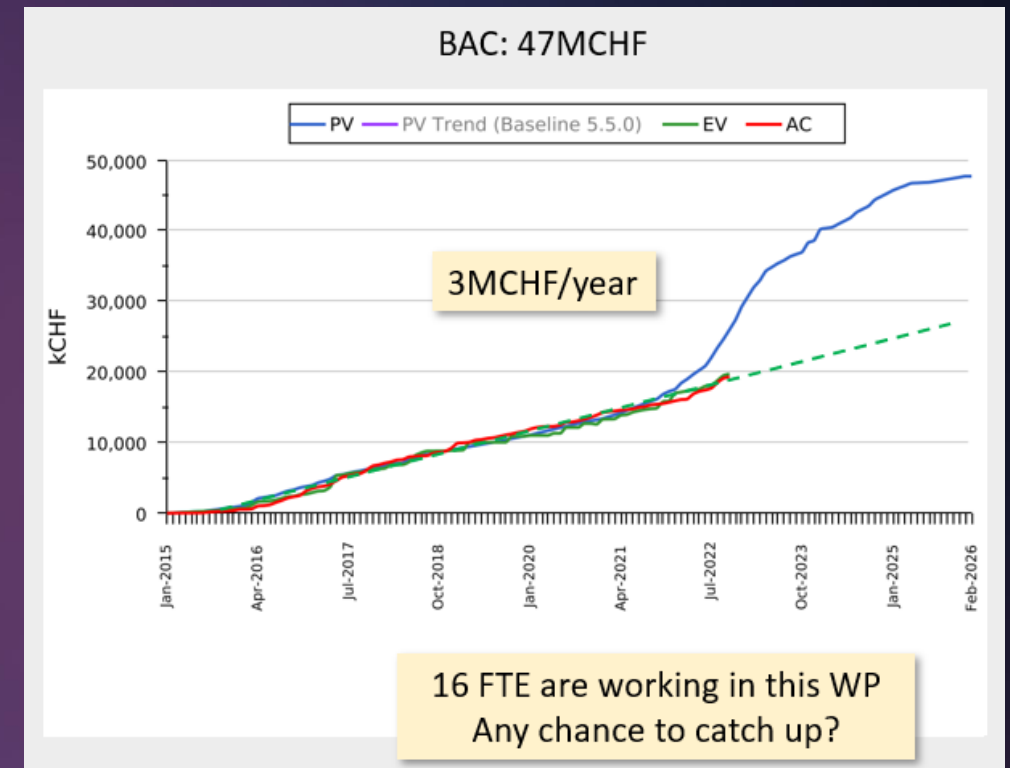
## HERE:

A WP working largely by internalized fabrication

Very few "off-the-shelf" components

No large external contracts

If no extra resources are injected,  
the WP will run late



# Conclusions and limitations

- ❖ **EVM is essential** in PM planning, monitoring, managing change, and closing activities.
- ❖ Its effectiveness in analyzing and reporting is proven but requires **good input data**.  
**Correcting a bad initial construction is heavy.**
- ❖ The relationship between EVM and CET is very weak, causing a laborious manual process for data maintenance, change management, closing activities...
- ❖ **Collaboration between the WPs and the Monitoring and Control Office (MCO) team ensures the EVM operates effectively and achieves accurate results.**



**THANK YOU FOR  
YOUR TIME**