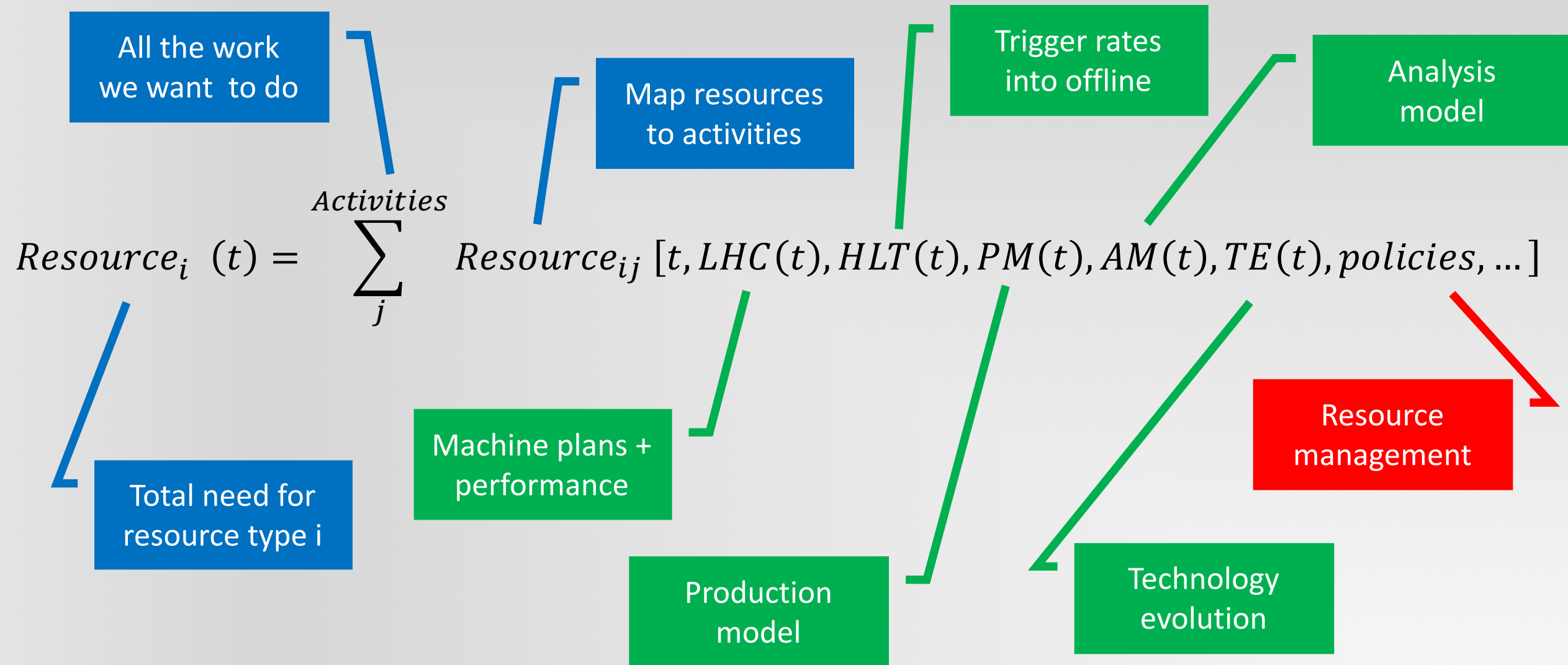# Resource modeling group

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Context

- WLCG/HSF Naples meeting ideas: define a **common FW for modeling the computing requirements** of LHC (and HEP in general) experiments

- We have since understood that experiments are different enough that reaching this goal might mean a tool that is not useful (eg, too low fidelity) to capture requirements well enough to be input to cost modeling.

- However, being more open with code and ideas means we have made good progress this year
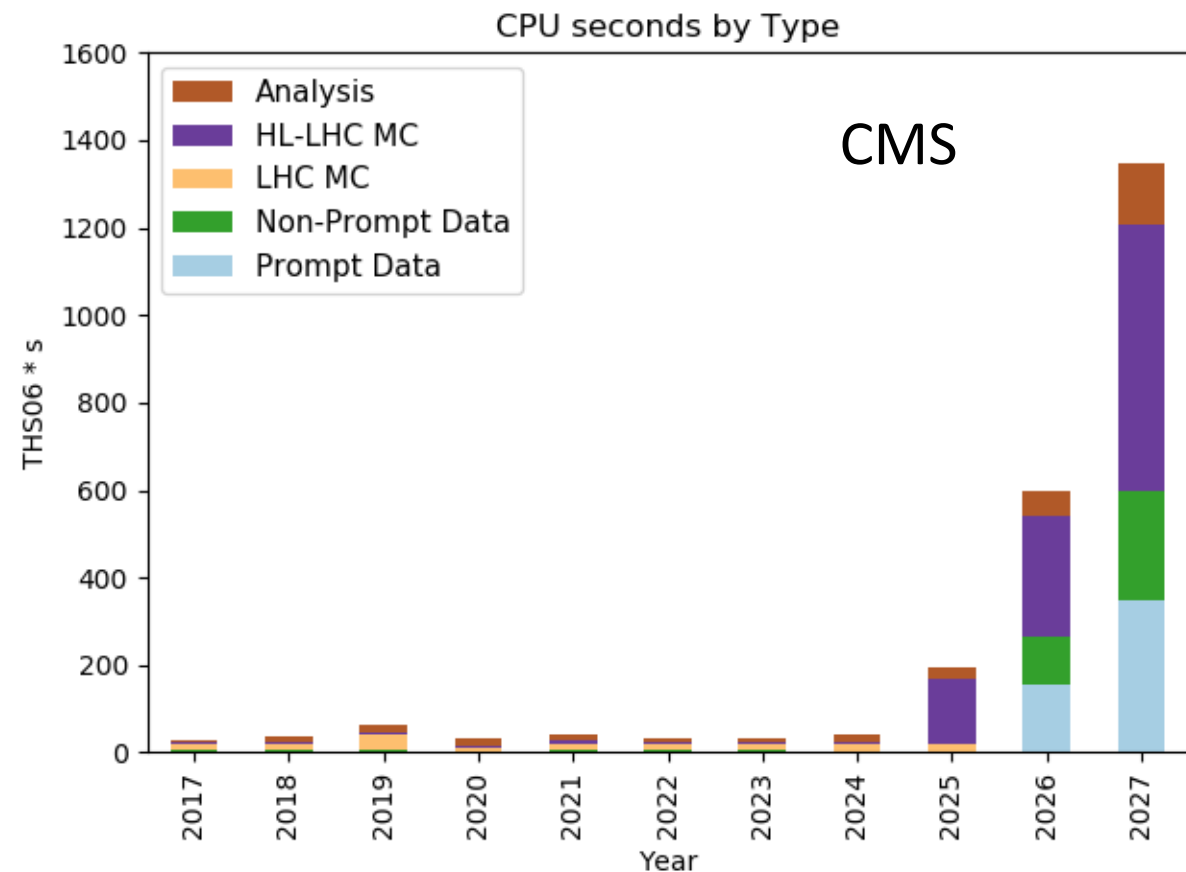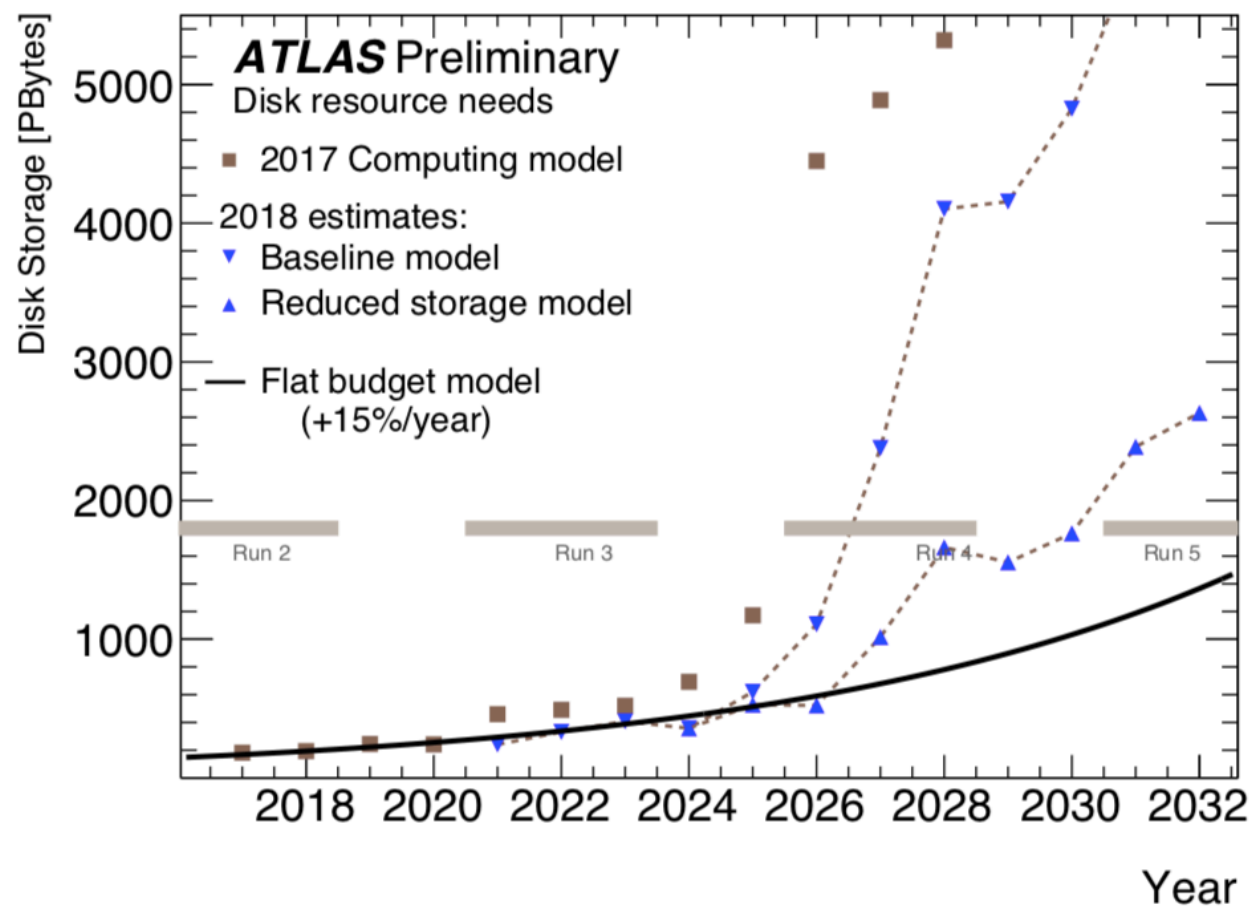
Implementation approaches

- Experiments each have active efforts to keep short and long term resource estimates up to date
    - Driven partly by requests from C-RSG / LHCC / national reviews

- There are numerous models in use. These vary in complexity, but have a common underlying approach
    - Start from model current processing activities (data, MC processing), disk replication factors, and tape usage
    - Extrapolate current practice into the future accounting for LHC conditions, trigger rates, expected luminosity, etc
    - Adjust based on R&D expectations (eg, application software improvements, analysis data tier evolution)

The idea behind resource models is quite simple

All the work we want to do

Map resources to activities

Trigger rates into offline

Analysis model

$$Resource_i\ (t) = \sum_j^{Activities} Resource_{ij}\ [t, LHC(t), HLT(t), PM(t), AM(t), TE(t), policies, ...]$$

Total need for resource type i

Machine plans + performance

Production model

Resource management

Technology evolution

Example projections

Outputs and capturing R&D

- Model outputs are yearly estimated resource needs
  - We see little need to monitor results at timescales shorter than yearly. Resources are always full. Any peaks/valleys in planned processing requirements get smoothed out or filled in by opportunistic processing.

- Difficult to anticipate impact of R&D or behavioral changes before they happen
  - Models based on current practice
  - Conversely : We can anticipate by setting "goals" for how R&D may change input parameters (examples: future data tier size reductions, application software speedup)

State of affairs

- Collaboration around approaches and implementations
  - No common code base, but increased openness in codes
- Parameters behind estimates (which are numerous!) are generally kept internal
  - Experiments are different enough that the methodology of deriving these parameters is specific to each experiment
    - Can be/have been validated against actual grid job performance attributes
  - Or not?
    - Should Atlas / CMS use common representative benchmarks to derive application parameters (keeping in mind that there are important differences in our approach to generators for Monte Carlo simulation)
    - Infrastructure parameters more in common (but mostly discussed/agreed long ago)

Interfacing to cost group - model outputs

Metrics currently reported

1. CPU (eg, HS06 seconds of compute needed)

2. Disk (PB of storage)

3. Tape (PB of storage)

- We presume there is no need to separate by Tier0/Tier-1/Tier-2 in the context of HL-LHC. In any case the boundaries between these are blurring

Where should this work go:

Priorities for New metrics in models

Potential new metrics: Tape I/O

- More interesting (which is to say worrisome)
  - HL-LHC brings large increase in data volume – eg, 50x increase in RAW data volume for CMS
  - I/O capabilities are increasing less quickly than storage capabilities

- Aggregate I/O estimates are straightforward to include
  - Beyond just computing the total PB to tape per year, its important to estimate average need during data taking periods
  - Safety factors needed in order to account for bursts and finite disk buffer sizes are likely best understood by studying monitoring data

Potential new metrics: Networks

- Local:
  - Probably too hard and too variable to include in models
    - Data center setup and configuration
    - Job stage-in / stage-out

- Regional (from dataset transfers and remote file reads)
  - Initially a lower-bound estimate
  - Eventually a way to evaluate DOMA R&D

- Inter-regional (from dataset transfers and remote file reads):
  - Initially a lower-bound estimate
  - Eventually a way to evaluate DOMA R&D

Potential new metrics: Accelerators

- We can hide behind HS06 or its successors so that we can think of accelerators in the same way as CPUs

- Otherwise too early to be able to include in models explicitly

Questions for discussion

- Is this status sufficient for answering questions in this WG? So far it appears to be, and experts from each experiment are engaged to answer specific studies when they arise.

- Any particularly important model parameters, methods or assumptions that should be revisited?

- Additional metrics that are useful for us to extract from models (for this WG or others)?