The Origins of EVM

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The Challenge

"Those who don't study history are doomed to repeat it. Yet those who *do* study history are doomed to stand by helplessly while everyone else repeats it."

For my work on project management history see: https://mosaicprojects.com.au/PMKI-ZSY.php

This presentation is based on a paper in development

The Challenge

Prediction is very difficult, especially if it's about the future!

Niels Bohr, Nobel laureate in Physics

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The Challenge

- **BUT…….**
- A consistent theme running through this Symposium is the requirement to provide accurate forecasts of future outcomes:
  - Risk and uncertainty make forecasting difficult
  - Senior management want accurate forecasts to inform decisions
  - Not knowing the outcome = poor governance (but today we have the tools)
- **The value of project controls is providing management with early warning of potential undesirable outcomes so action can be taken to prevent the predictions coming true!**
- This paper shows systematic processes to predict outcomes only emerged in the 1960s and are still not widely used

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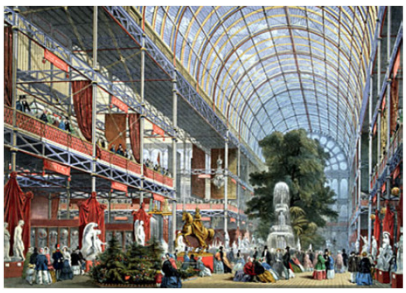
The Challenge

- Contracts with deadlines and fixed prices have been around for at least 2000 years
- Forecasting costs to complete on major projects has a long history
- Crystal Palace / Great Exhibition
  - Forecast profit 1853 'Not less than £173,000'
  - Actual December 1855: £186,436 18s 6d

  (Battle of Waterloo 1815)



https://mosaicprojects.com.au/PDF_Papers/P180-Project_Governance-Building_the_Crystal_Palace.pdf

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The Challenge

- Planning work also has a long history
- Henry Gantt 1910 - 1920

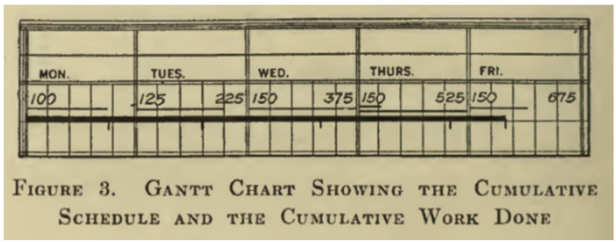

FIGURE 3. GANTT CHART SHOWING THE CUMULATIVE SCHEDULE AND THE CUMULATIVE WORK DONE

https://mosaicprojects.com.au/PDF_Papers/P158_Henry_L_Gantt.pdf

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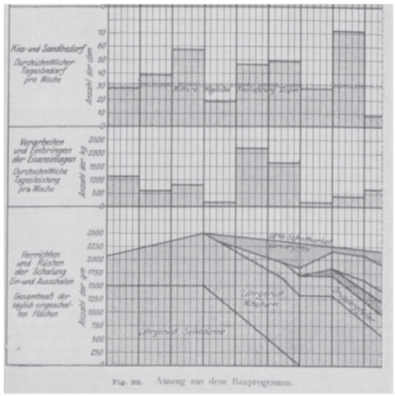
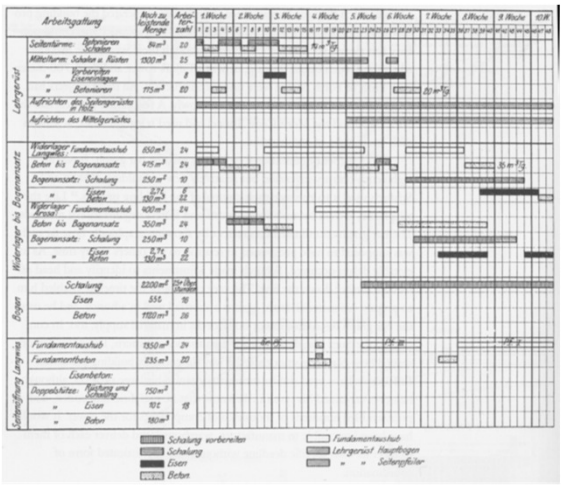
The Challenge

- Planning work has a long history
- 1912 Schürch barchart





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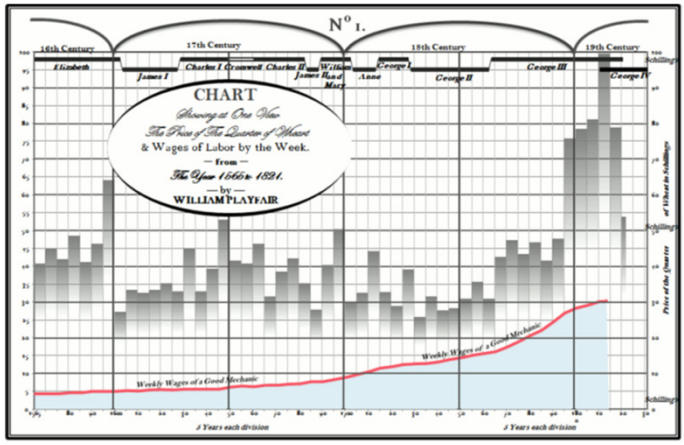
The Challenge

- The use of charts to display data is even older
- William Playfair 1810 through to 1825



https://mosaicprojects.com.au/PDF_Papers/P042_History_of_Scheduling.pdf

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Prior to the 20th Century

1. All of the diagrams were static (Karol Adamiecki was an exception)
2. Tools did show current situation -v- the plan
3. This information was undoubtedly used to assess outcomes
4. But no standard process was developed to predict outcomes

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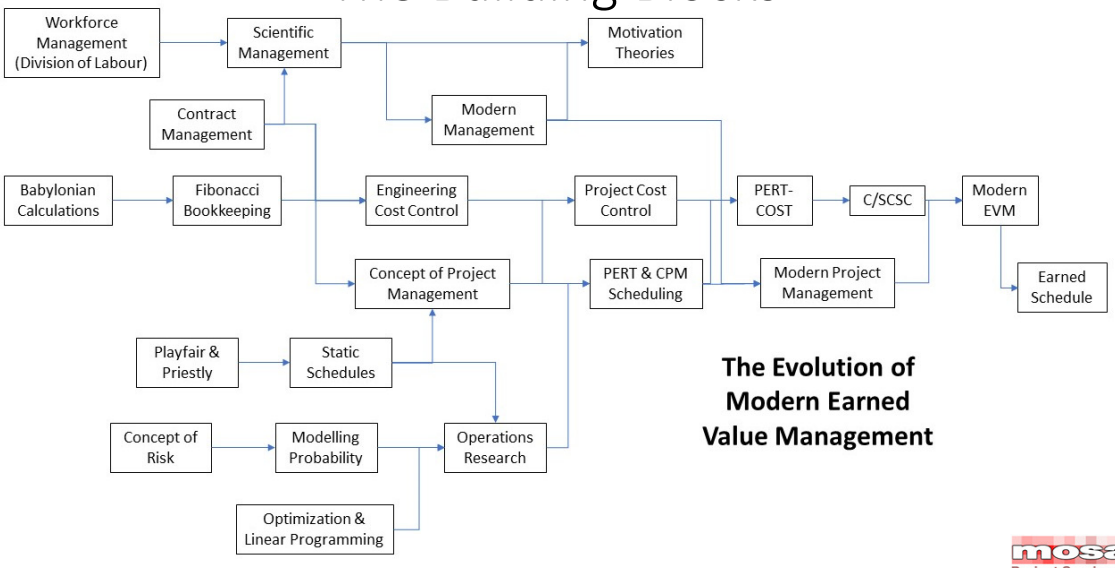
The Building Blocks



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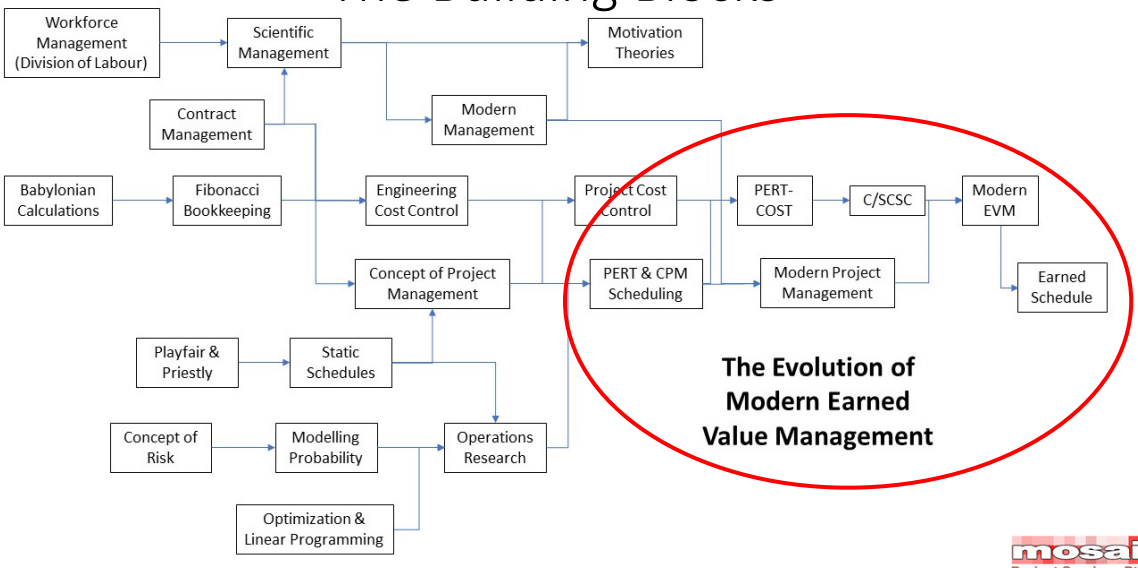
The Building Blocks



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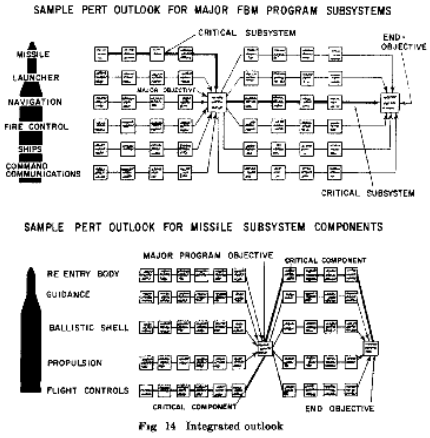
PERT & CPM Schedules

- Dynamic modelling of time
- Updates predicted outcomes
- CPM = deterministic
- PERT = probabilistic
- Weakness - both assume all future work will be performed as planned
- Developed 1956 / 1958



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PERT Cost & WBS

- June 1962, DoD and NASA published the PERT/COST system
- Included description of WBS

PERT COST

MANAGEMENT SUMMARY REPORT

The PERT COST Management Summary Report shows current and projected schedule and cost status of the total program and of each of the major component items or elements within the program. The report is prepared at several levels of the work breakdown structure and for all contracts or a specified combination of contracts, depending upon the needs of management. The report may be machine produced, but when it is manually prepared, the necessary information is derived from the Program/Project Status Report.

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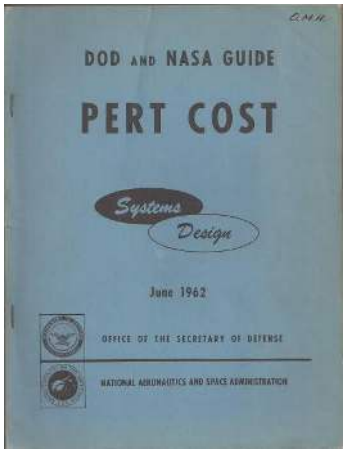
PERT Cost & WBS

- Cost estimates were based on a 3 point estimate (normal 'PERT')
- Value of work accomplished was assessed based on progress (not amount spent)
- Actual costs were collected from contractors, etc.
- The cost to complete was assessed based on the resources expected to be used to complete each activity (in effect a re-estimate)
- Unlike schedule, cost reporting was initially a manual process



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PERT Cost & WBS

PERT COST
MANAGEMENT SUMMARY REPORT

①	REPORTING ORGN. ③	CONTRACT NO. ④	REPORT DATES ITERM (SPAN): CUT OFF DATE: RELEASE DATE: ⑤
LEVEL/SUMMARY ITEM: ②			

ITEM	COST OF WORK $(000)						MOST CRIT SLACK (WKS)	COMPL DATE	SCHEDULE S-SCHED COMPL DATE--TOTAL A-ACTUAL COMPL DATE-- ITEM E-EARLIEST COMPL DATE--CRITICAL L-LATEST COMPL DATE-- ITEM	REMARKS
	WORK PERFORMED TO DATE			TOTALS AT COMPLETION						
	VALUE	ACTUAL COST	(OVERRUN) UNDERRUN	PLANNED COST	LATEST REVISED EST	PROJECTED (OVERRUN) UNDERRUN				
⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑯	⑰
					NUMBER OF DIGITS					
18	7	7	9	7	7	9	5	8	33	
						(.xx)				
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					DATA SPACES 119	110 9				

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PERT Cost & WBS

⑥ ITEM: The level number, noun description, and summary number of each summary item on the work breakdown structure for which time information and cost information are presented in the report. The first item shown is the highest item for which the particular report is prepared and should be identical with the item named in the Level/Summary Item block ②. Three lines are available for each item description, and, if necessary, the top line may be extended into the Cost of Work columns ⑦ - ⑫.

⑦ VALUE (Work Performed to Date): The total planned cost for work completed within the summary item. This value is determined by summing the Planned Cost ⑩ for each completed work package. If a work package is in process, the part of its total planned cost which applies to work completed is approximated by applying the ratio of Actual Cost ⑧ to Latest Revised Estimate ⑪ for that work package.

⑧ ACTUAL COST (Work Performed to Date): The actual expenditures incurred plus any prespecified types of unliquidated commitments (unliquidated obligations or accrued liabilities) charged or assigned to the work packages within the summary item.

⑨ (OVERRUN) UNDERRUN (Work Performed to Date): The Value ⑦ for the work performed to date minus the Actual Cost ⑧ for that same work. When value exceeds actual cost, an underrun condition exists. When actual cost exceeds value, an overrun condition exists. The (overrun) underrun is also expressed as a percentage of the value of work performed to date immediately above the dollar amount. Parentheses are used as a notational device to indicate overruns. (Over)underruns in excess of one billion dollars print as 999,999.

⑩ PLANNED COST (Totals at Completion): The approved planned cost for the total summary item. This is the total of the planned costs for all work packages within the summary item.

⑪ LATEST REVISED ESTIMATE (Totals at Completion): The latest estimate of cost for the total summary item. This estimate is the sum of the actual costs plus estimates-to-complete for all the work packages in the summary item. This estimate is also known as anticipated final cost. For a completed item, the latest revised estimate equals the Actual Cost ⑧.

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PERT COST
COST OF WORK REPORT

①	REPORTING ORGN ③	CONTRACT NO. ④	REPORT DATES TERM (SPAN): CUT OFF DATE: RELEASE DATE: ⑤
LEVEL/SUMMARY ITEM: ②			

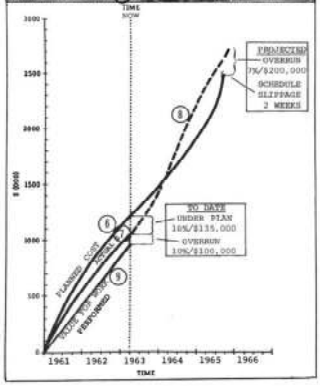

Figure 15

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PERT Cost & WBS

Estimate-to-Complete

The estimated manhours, costs, and time required to complete a work package or summary item, (includes applicable overhead except where only direct costs are specified)

Note: The forward estimate should not be based on estimated cost – actual cost!

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PERT Cost & WBS

- The foundation of modern EVM is undoubtedly PERT/Cost
- Concepts include:
  - The WBS and work packages
  - Planned Value
  - Earned Value (approximated for WIP)
  - Estimate to Complete, but based on a re-estimating process typically only applied to open work packages
- The system was labour intensive and strongly opposed by most Govt. contractors forced to use the system

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Cost Schedule Planning and Control Specification (CSPCS)

- CSPCS is where the term ‘C-Spec’ originated
- Published as Annex 4 of Air Force Systems Command Manual (AFSCM) 70-5 in 1966 and revised in June 1967
- Defined 26 "specifications" that a contractor's system had to meet
- Limited application

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C/SCSC

- Cost/Schedule Control Systems Criteria” (C/SCSC or CS2)
- DoDI 7000.1 1966 started the application of EVM based on ‘C-Spec’
- DoDI 7000.10, 1974 defined the standard reports and calculations
- DoDI 7000.2, 10 June 1977 – definitive version
  - 35 Criteria
  - Required the use of standard formula
  - Required the use of standard reports

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EIA-748-1998

- Published 1998
- Adopted by US DoD on 17 Aug 1999
- Updated version of DoD Instructions, still
  - 35 Criteria
  - Required the use of standard formula
  - Required the use of standard reports
- EIA-748-A, 2002
- EIA-748-D, 2019 reduced 'criteria' to 32

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Australia

- Adopted EVM for Defence contracts 1990/91
  - Def(AUST) 5655, 5657, 5658, 5664
  - Same basis as DoDI 7000.2
- AS 4817 2003 introduced 'objectives' rather than 'criteria'
- AS 4817 2006 updated the standard
- ISO 21508 2018 based on AS 4817 2006, and
- AS4817-2019 based on ISO 21508:2018

- The concept of EVM is spreading (slowly)

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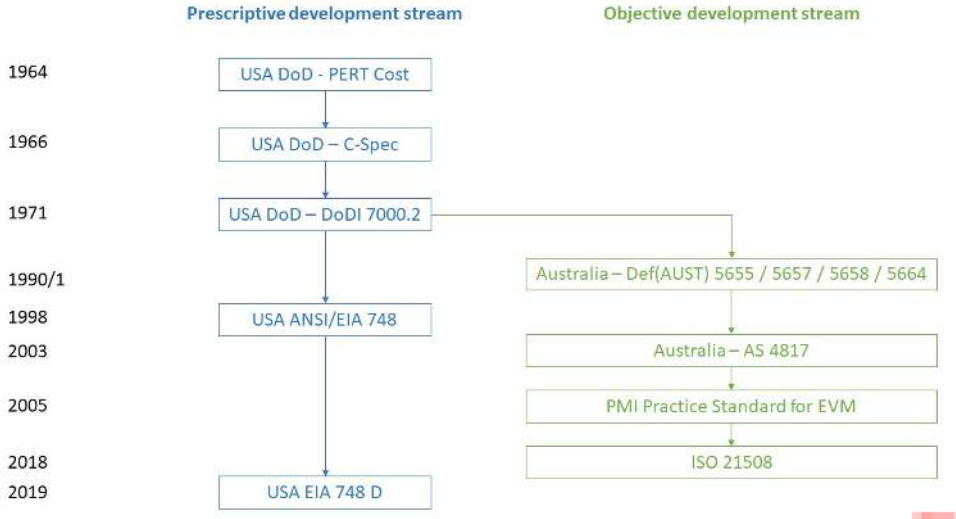
EVM – Concept Spreading



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Limited Adoption of EVM

- Source: *Earned Value -A Leading Indicator of Clean Governance*
  Paul D Giammalvo
  PM World Journal. Jan. 2019
- Blue callout = Adopted
- Red callout = Recognised

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Work Still To Do

- For me:
  - Find some of the key early documents
  - Complete the written paper
  - Publish with on-line versions of the core documents to provide a proper historical resource
- For you:
  - EVM supported by ES is the only standard method of predicting project outcomes based on actual performance to date
  - Keep focused on delivering the quality of control information needed by your senior executives

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Thank You

- **Questions ??**
- Other project management history resources: https://mosaicprojects.com.au/PMKI-ZSY.php
- Patrick Weaver: patw@mosaicprojects.com.au

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