10TH INTERNATIONAL DESIGN STRUCTURE MATRIX CONFERENCE, DSM'08
11 – 12 NOVEMBER 2008, STOCKHOLM, SWEDEN

APPLYING APOLLO TO DSM FOR SCHEDULE ADHERENCE VISUALISATION

Paschal Minogue
Analog Devices B.V.

Keywords: Apollo, DSM, performance to schedule, schedule adherence visualisation

1 INTRODUCTION

The current, standard, DSM approach [1], [2], (when used specifically for tasks) is limited in that it does not capture performance to schedule or schedule adherence. DSM is designed to capture task relationships/dependencies, not slippage.
We can learn from approaches taken in (ultimately) successful projects like the Apollo (lunar missions) program in the 1960's, which had a particularly powerful method of capturing and visualising slippage [3].
Applying an Apollo schedule adherence visualisation technique to DSM can potentially extend its scope and usefulness.

2 CURRENT DSM APPROACH AND LIMITATIONS

The current DSM approach [1], [2], when applied to tasks, captures relationships/dependencies by listing various tasks simply on both x- and y-axes, as shown in the simplified example in Figure 1.

DSM	Task	Task1	Task2	Task3
Task				
Task1				
Task2		x		
Task3			x	

Figure 1. Current DSM Approach – Basic Method

This approach, whilst it is a powerful visualisation of task dependencies, does not capture schedule adherence or slippage.

3 SCHEDULE TRACKING IN THE APOLLO PROGRAM

The Apollo program used project status review charts like those shown in Figure 2 [3]. These versatile aids allowed the visualisation, on a single chart, of the originally planned project duration, the latest planned project duration, the rate of slippage, the actual project duration and the project duration update history.
The approach effectively plotted time (i.e. anticipated launch date in the example shown in Figure 2) versus time (i.e. report or schedule review date in the example shown) to illustrate adherence to schedule of a key event.

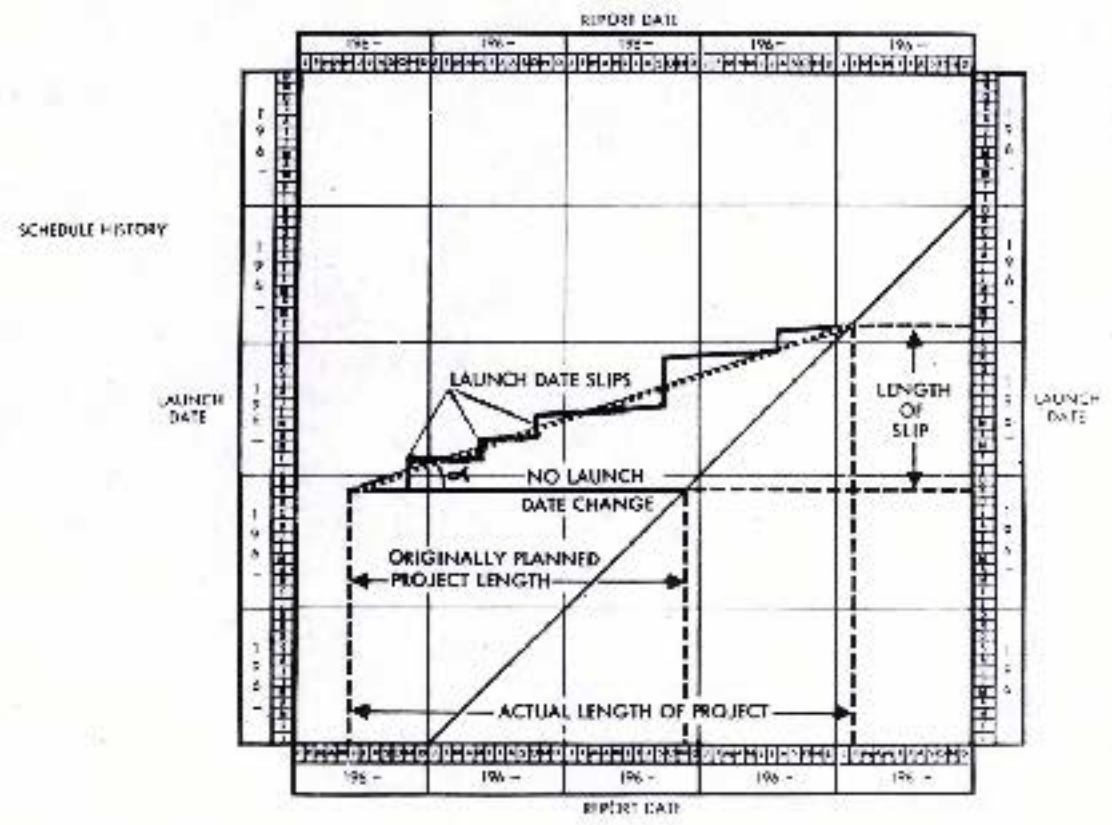


Figure 2. Apollo Project Status Review Chart Concept

[Source: (Deputy Associate Administrator 1964, p. 7)]

The clear benefit of this particular approach is the powerful visualisation of the adherence to schedule on a single chart.

4 NEW DSM APPROACH AND BENEFITS

The suggested new DSM approach lists tasks and effectively durations on both x- and y-axes, as shown in Figure 3. The latter matrix shows baseline durations in time units on both axes e.g. the duration of "Task2" is anticipated to be twice that of "Task1", whereas the duration of "Task3" is predicted to be three times that of task "Task1". The introduction of time units or durations into the matrix can be done before or after the usual sequencing and tearing manipulations are performed, since the outcome is still a DSM.

DSM		Task	Task1	Task2	Task3
		Time	1	2	3
Task	Time				
Task1	1		**0**		
Task2	2		x	**0**	
Task3	3			x	**0**

Figure 3. New DSM Approach – Basic Method

An update to the matrix can continue to show the baseline durations on the y-axis and the actual durations on the x-axis, as illustrated in Figure 4. In the latter example, "Task2" takes three times its originally planned time and "Task3" takes two-thirds of its originally planned time. Therefore, slippage, as well as being noted numerically in the shaded cells, can also be more clearly visualised as "drift" in the x-direction. It is this adherence to schedule visualisation that is the key advantage of the new approach.

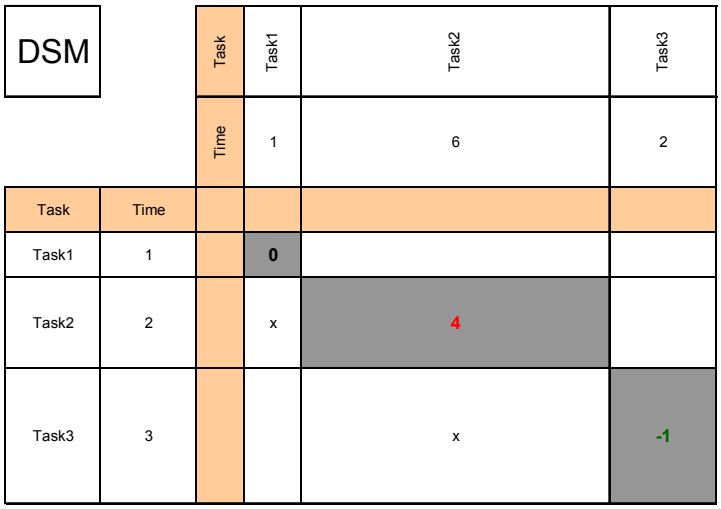


Figure 4. New DSM Approach – Example

This new DSM approach, which can also be applied to more complex scenarios than the simple examples shown, combines two powerful visualisation methods into one i.e. the schedule task relationship visualisation ala DSM and the adherence to schedule visualisation ala Apollo.

5 SUMMARY

The current, standard, DSM approach, when used specifically for tasks, is limited in that it does not capture performance to schedule. It is designed primarily to capture relationships, not slippage.
We can learn from approaches taken from successful projects like Apollo, which employed a particularly powerful method for capturing and visualising adherence to schedule on one chart.
The new DSM approach, when used specifically for tasks, can capture both (task) relationships and adherence to schedule, thereby extending the scope and usefulness of the DSM.

REFERENCES

[1] Ulrich K.T. and Eppinger S.D. *Product Design and Development, Chapter 16: Managing Projects – The Design Structure Matrix* International Edition 2003 (McGraw-Hill, New York), pp. 334-335.

[2] Eppinger S.D. Using DSM for Project Planning. In *Managing Complex Product Development Projects, Day 1,* Cambridge, Massachusetts, December 7-8, 2006 (MIT, Sloan School of Management).

[3] Deputy Associate Administrator (1964) *Studies relating to Management Effectiveness in Scheduling and Cost Estimating NASA projects*, Office of the Administrator: NASA (internal report).

Contact: Paschal Minogue
Analog Devices B.V.
Design Department
Raheen Business Park
Limerick
Ireland
Phone: 00-353-61495307
Fax: 00-353-61495868
e-mail: paschal.minogue@analog.com

ANALOG DEVICES

10TH INTERNATIONAL DSM CONFERENCE

Applying Apollo to DSM for Schedule Adherence Visualisation

Paschal Minogue

Analog Devices B.V.

Technische Universität München

FOLLOW THE FLOW OF INFORMATION!
MANAGE COMPLEX SYSTEMS

ANALOG DEVICES

Index

Technische Universität München

ANALOG DEVICES

Introduction

- The current, standard, DSM approach (when used specifically for tasks) is limited in that it does not capture performance to schedule
  - It is designed primarily to capture relationships, not slippage
- We can learn from approaches taken in successful projects like Apollo
  - The latter had a particularly powerful method for capturing and visualising slippage
- Applying an Apollo schedule adherence visualisation technique to DSM can potentially extend its scope and usefulness

ANALOG DEVICES

Current DSM Approach – Basic Method

DSM	Task	Task1	Task2	Task3
Task				
Task1				
Task2		x		
Task3			x	

- When applied to Tasks
- Tasks listed on both x and y axes
- Captures relationships/dependencies between tasks

ANALOG DEVICES

Current DSM Approach – Example

- Example shows a DSM after sequencing/partitioning and tearing manipulations
- Example shown is based on one given in: (Eppinger 2006, p. 8-9)

DSM	Task	Task2	Task3	Task1	Task11	Task12	Task10	Task6	Task9	Task5	Task4	Task8	Task7
Task													
Task2													
Task3		x											
Task1			x										
Task11		x	x										
Task12				x	x		x		(x)				
Task10		x	x		x	x							
Task6		x				x			x				
Task9			x				x	x					
Task5					x			x				x	
Task4						x		x		x			
Task8				x	x				x		x		
Task7		x			x								

Series Tasks

Parallel Tasks

"Torn" or Control

Coupled Tasks

Coupled Tasks

Reference:
Eppinger S.D. Using DSM for Project Planning.
In *Managing Complex Product Development Projects, Day 1*,
Cambridge, Massachusetts, December 7-8, 2006 (MIT, Sloan School of Management)

FOLLOW THE FLOW OF INFORMATION!
MANAGE COMPLEX SYSTEMS

ANALOG DEVICES

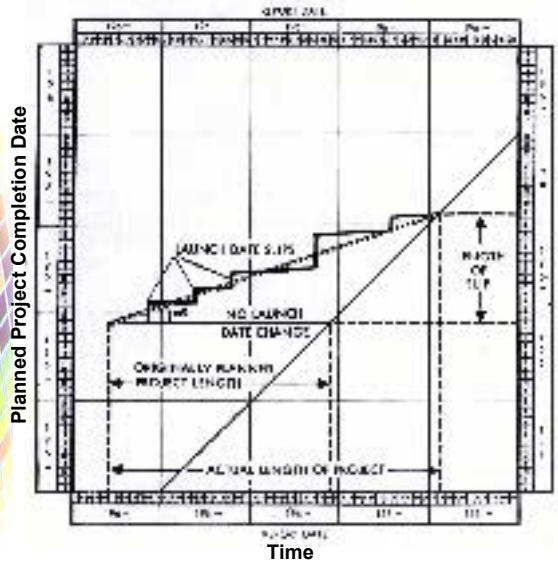
Current DSM Approach – Key Limitations

- The current, standard, DSM approach (when used specifically for tasks) is limited in that
  - it does not capture performance to schedule or slippage
  - it does not capture any scheduling updating history
  - it does not facilitate project completion timescale prediction
- This is not surprising in that a standard DSM approach is designed to capture (task) relationships/dependencies, not any time-related parameters like task durations or slippage

ANALOG DEVICES

Schedule Tracking in the Apollo Program – Basic Method

Planned Project Completion Date versus Time



- Use of Project Status Review Charts
- The following can be visualised on a single chart
  - Originally planned project duration
  - Latest planned project duration
  - Rate of slippage
  - Actual project duration
  - Project duration update history
- Source: (Deputy Associate Administrator 1964, p. 7)

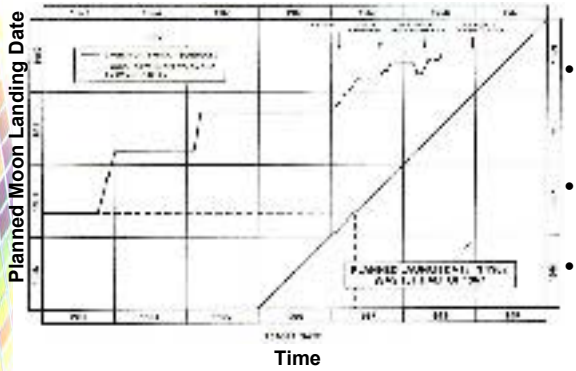
Reference:
Deputy Associate Adminstrator (1964)
Studies relating to Management Effectiveness in Scheduling and Cost Estimating NASA projects,
Office of the Administrator: NASA (internal report)

FOLLOW THE FLOW OF INFORMATION!
MANAGE COMPLEX SYSTEMS

ANALOG DEVICES

Schedule Tracking in the Apollo Program – Example

Planned Moon Landing Date versus Time



- Schedule Slippage in the Apollo Program
- At the beginning of 1963, the planned date for the first moon landing was the first half of 1967
- The actual first moon landing was achieved in the middle of 1969
- The overall rate of slippage was about 0.5 year per year
- The project duration update history shows the reduction in the rate of slippage
- Source: (Rees 1989, p. 30)

Reference:
Rees, D.E. (1989)
Project and Systems Management in the Apollo Program
(contained within Issues in NASA Program and Project Management edited by Francis T. Hoban),
Washington, D.C.: NASA)

ANALOG DEVICES

Schedule Tracking in the Apollo Program – Key Benefits

- Powerful visualisation of the adherence to schedule on one chart
- History of project completion estimate updates and corresponding schedule impacts captured on one chart
- Facilitates final project completion timescale prediction by extrapolation

ANALOG DEVICES

New DSM Approach – Basic Method

DSM		Task	Task1	Task2	Task3
		Time	1	2	3
Task	Time				
Task1	1		**0**		
Task2	2		x	**0**	
Task3	3			x	**0**

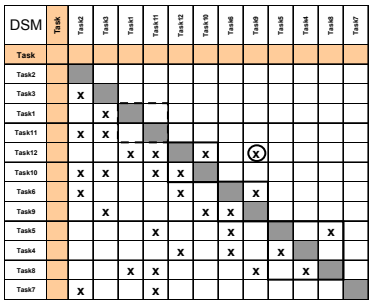
- Combine two visualisation methods into one
  - adherence to schedule visualisation ala Apollo
  - schedule task relationship visualisation ala DSM
- Matrix shown with baseline durations
- “Square-shaped” central shaded boxes indicate planned schedule

New DSM Approach – Example

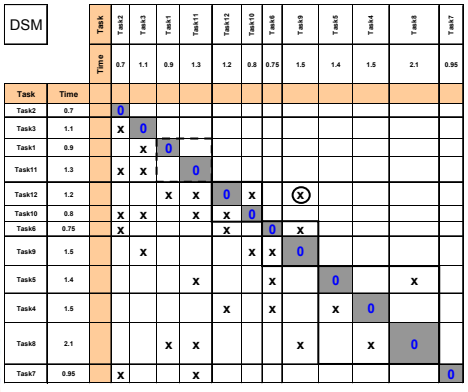
DSM		Task	Task1	Task2	Task3
		Time	1	6	2
Task	Time				
Task1	1		0		
Task2	2		x	4	
Task3	3			x	-1

- Matrix shown with
  - Baseline durations on y-axis
  - Actual durations on x-axis
- Adherence to schedule shown
  - "Task2" takes 3X planned time
  - "Task3" takes (2/3)X planned time
  - Slippage visualised as "drift" in x-direction
  - "Non-square-shaped" or "rectangle-shaped" central shaded boxes indicate deviation from planned schedule

New DSM Approach - Usage Strategy - Introducing Time



- Time can be introduced at the start, before sequencing algorithms or at the end after all manipulations



- The outcome is still a DSM

ANALOG DEVICES

New DSM Approach - Usage Strategy - Dealing with Complexity

– Application to a more complex example

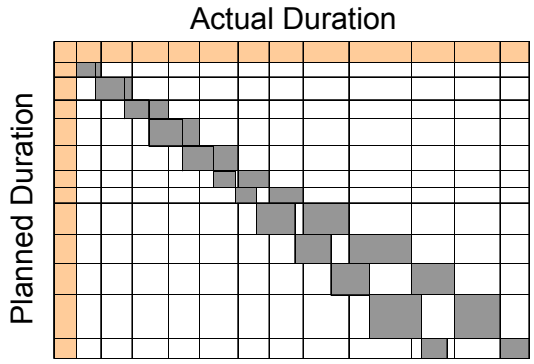
DSM

Task	Time	Task2	Task3	Task1	Task11	Task12	Task10	Task6	Task9	Task5	Task4	Task8	Task7
		0.9	1.2	1.4	1.2	1.5	1.2	1.3	1.8	2.5	1.7	1.8	1.25
Task2	0.7	0.2											
Task3	1.1	x	0.1										
Task1	0.9		x	0.5									
Task11	1.3	x	x		-0.1								
Task12	1.2			x	x	0.3	x		⊗				
Task10	0.8	x	x		x	x	0.4						
Task6	0.75	x				x		0.55	x				
Task9	1.5		x				x	x	0.3				
Task5	1.4				x			x		1.1		x	
Task4	1.5					x		x		x	0.2		
Task8	2.1			x	x				x		x	-0.3	
Task7	0.95	x			x								0.3

ANALOG DEVICES

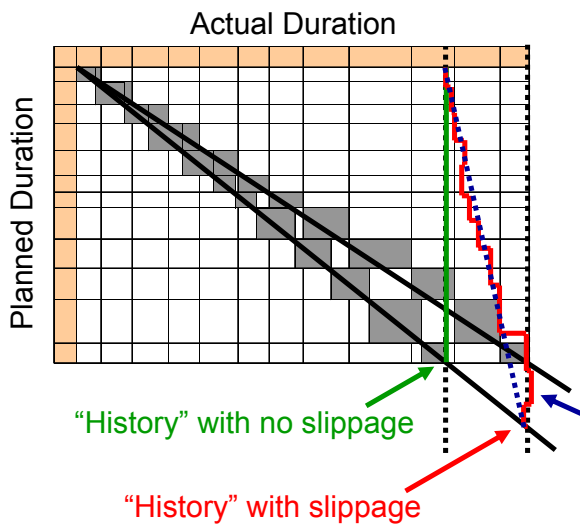
New DSM Approach - Usage Strategy - Tracking

– Overlay baseline durations on actual durations
– Overall schedule slippage is observed as “drift” in the x-direction



ANALOG DEVICES

New DSM Approach - Usage Strategy - History

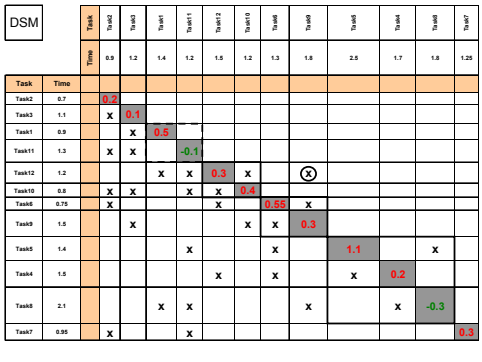


- Overlay baseline durations on actual durations
- Update estimated overall duration as the project progresses
- Final project completion timescale could potentially be predicted by extrapolation
- "History" of planned overall duration can be plotted versus time also

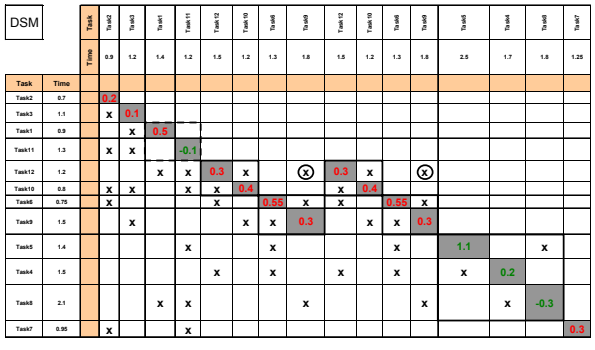
FOLLOW THE FLOW OF INFORMATION!
MANAGE COMPLEX SYSTEMS

ANALOG DEVICES

New DSM Approach - Usage Strategy - Dealing with Iterations



- First scenario shows no overall iteration



- Second scenario illustrates an iteration after "Task9" is executed

New DSM Approach – Key Benefits

- As well as the usual powerful visualisation of (task) relationships, the new DSM approach (when used specifically for tasks) has the following additional benefits:
  - Powerful visualisation of adherence to schedule on one chart
  - History of project completion estimate updates and corresponding schedule impacts captured on one chart
  - Facilitates final project completion timescale prediction by extrapolation

Summary

- The current, standard, DSM approach (when used specifically for tasks) is limited in that it does not capture performance to schedule
  - It is designed primarily to capture relationships, not slippage
- We can learn from approaches taken in successful projects like Apollo
  - The latter had a particularly powerful method for capturing and visualising adherence to schedule on one chart
- The new DSM approach (when used specifically for tasks) can capture both (task) relationships and adherence to schedule on one chart, thereby extending the scope and usefulness of the DSM
  - The new approach can also facilitate schedule updating history/impact capture and final project completion timescale prediction