PRACTICAL WAYS OF DEALING WITH PROGRESS IN A DSM TOOL

Paul Waskett[1], Andrew Newton[1], John Steele[2] and Jamie Hammond[2]
[1]Adept Management Ltd
[2]AML Technologies

Keywords: ADePT, DSM, progress monitoring, commercial software, industrial implementation.

1 INTRODUCTION

The 'ADePT' methodology was devised in 1995 (Austin et al., 1999a, 1999b, 2000) and developed into prototype software between then and 2005. The methodology, which has a DSM partitioning algorithm at its heart, has been widely implemented in industrial design projects, primarily in the Architecture, Engineering and Construction (AEC) sector but also in the fields of manufacturing, defence, aerospace, IT, and business management. Examples of implementation have been reported at previous DSM conferences (Waskett et al., 2005, Newton et al., 2007).

A decision was made in 2006 to develop ADePT into a commercial software toolset. The availability of the tools, called 'ADePT Design', has greatly increased the uptake of DSM – around 200 projects have now used ADePT. This in turn has revealed new challenges: in particular we have seen that Project Managers, designers and engineers in industry often favour well-established practices, even if they are inefficient, over improved processes which have been determined using DSM. The ADePT Design software tools have been amended to now incorporate small but important features to encourage changes in traditional behaviour. Two such examples are described in this paper.

2 ADEPT

2.1 The ADePT technique

ADePT is a highly structured approach to planning, and subsequently managing, the design activities within a project. The approach is aimed at development of a design schedule which is fully integrated across the designers and based on the critical flows of information between members of the design team. Subsequent management of information flows is regarded as a much better way of controlling the design process than simply monitoring production of deliverables or rate of fee spend. There are three stages to planning with ADePT, and a further management stage.

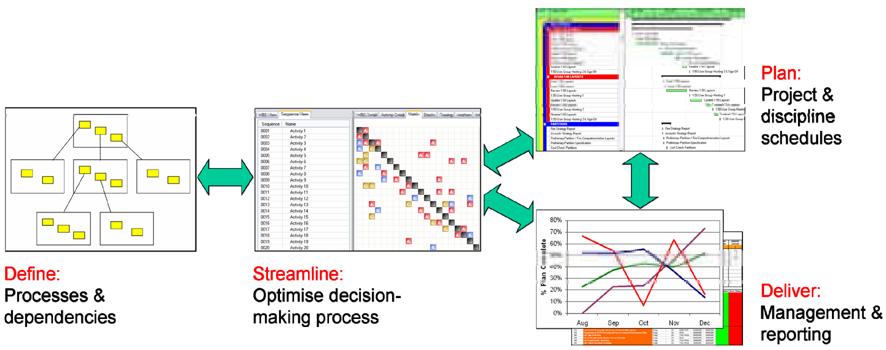


Figure 1. The ADePT Technique

ADePT employs a DSM partitioning algorithm to identify a sequence of activities which minimises the iteration in the design process and ensures any assumptions which the team need to make are ones which can be made with confidence. This is achieved by weighting the dependencies between activities. The calculation of a sequence prioritises the availability of outputs associated with the most critical dependencies. Any interdependent, iterative groups of activities which remain in the process following sequencing are often multi-disciplinary. They represent places in the design process where design team members should work concurrently to solve the interdependent problem. Usually they also represent elements of the product, and therefore of the design output, which require co-ordination.

Having produced a target design schedule, the design process needs to be controlled. ADePT incorporates an approach to process control which pre-empts deviation from the target schedule by analysing constraints, which then allows the schedule to be kept up-to-date and used in meaningful way.

2.2 The ADePT Design software suite

The ADePT Design software suite comprises two primary tools: ADePT Design Builder which enables the first two stages of the technique, including DSM, and ADePT Design Manager which enables the final stage. Both tools exchange data in two directions with commonly used scheduling applications including Microsoft Project and Oracle Primavera.

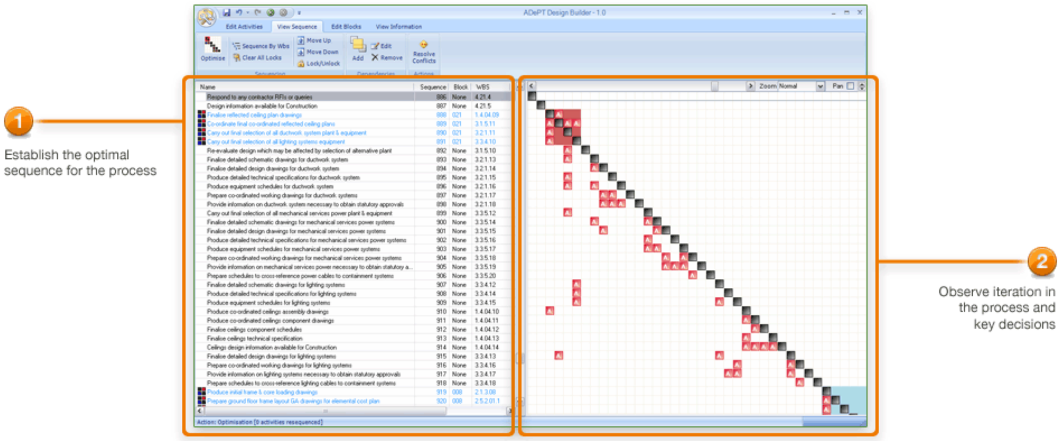


Figure 2. The DSM component within the ADePT software

3 PRACTICAL IMPLEMENTATION

3.1 Dealing with 'out-of-sequence' progress

Having identified iteration within design processes, and presented that iteration to design teams in the form of schedules and procedures, we had expected to see design teams adopt the discipline required to ensure that subsequent activities were not progressed until the iteration had been worked through. However, the reality was somewhat different: designers are normally keen to progress all parts of their project, especially if they perceive the project to be behind schedule, and this means commencing work without waiting for the preceding iterative processes to be completed. It also means undertaking some of the activities within an iterative loop of activities but leaving others un-started.

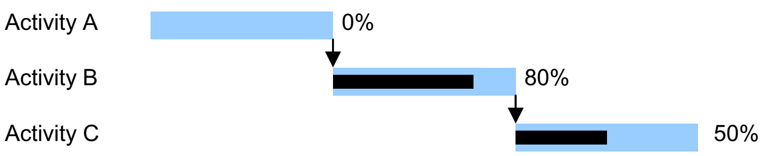


Figure 3. Out-of-sequence progress

We regard the completion of activities in an order that we call 'out-of-sequence' as bad practice. It suggests that the designers are continuing to follow their traditional, inefficient sequence. Most scheduling tools will happily allow this out-of-sequence progress to be entered, and while the more sophisticated tools will give the user options over how to handle the act of then rescheduling the project plan, they do not discourage the practice and, therefore, they also fail to encourage a more efficient process.

We have introduced a feature into the ADePT software tools that identifies any examples of this out-of-sequence progress and forces the user, normally Project Manager, to confirm one of the following:

- An activity recorded as progressed (for example, activity C in figure 3) is in fact not started;
- The preceding activity (activity B) is recorded as incomplete but is in fact fully complete – either way, there is the need in this example to ask a further question over how activity B can be progressed when activity A is not started;
- The progressed activity (C) is no longer dependent on the preceding activity (B). In this case a tear is likely to have been made courtesy of a designer making an assumption about the output from B and that assumption should be recorded; or
- Enough of the preceding activity (B) has been completed to generate an output which has enabled the following activity (C) to commence. Thus activity B is poorly defined, comprising as it does, two distinct steps with an output at the end of step one. In this case activity B should be split into two consecutive steps, with activity C dependent on the first step.

In our experience to date, the third of these options is the most likely. Users must capture all tears (assumptions) which are made throughout their project. Good Project Managers that we are working with understand that every assumption represents a risk, and so they are focusing their teams on undertaking activities in the sequence defined on the DSM, based on available design information, rather than on progressing based on such assumptions.

3.2 Accurately capturing progress

When defining a project, we break down the process into 'small' activities which can be measured more easily than larger ones. By this we normally mean that we define activities which should take typically between 1 and 20 days. This contrasts with many companies' common practices whereby they will happily show activities on schedules with durations of many weeks or months. As mentioned, this level of decomposition increases the ability to accurately measure progress. However, even with this breakdown we have seen progress reported in a variety of ways, leading to confusion about the overall progress on a project, as discussed below.

The root of the confusion seems to be the question of what is meant by 'progress' (a confusion which is often more common-place when implementing earned value management in design – see references APM 2002 and Meredith, J. R. and S. J. Mantel 2009). Sophisticated scheduling tools allow options including 'duration progress', 'effort or work progress', or 'physical progress' to be entered against activities, indicating the full array of meanings. Until recently we have not seen this word defined for the benefit of project teams; rather they have been left to draw their conclusion over which meaning applies. In defining the likely (or 'target') duration of activities in a plan, we are defining the timescale from start to finish of the activity. Therefore we need to capture 'duration progress' from the design team if we are to compare like with like. However when asking designers for the progress against an activity they tend to think of the proportion of work or effort which has been expended, against the total predicted, and, of course, it is widely recognised that effort and time do not necessarily share a directly proportional relationship.

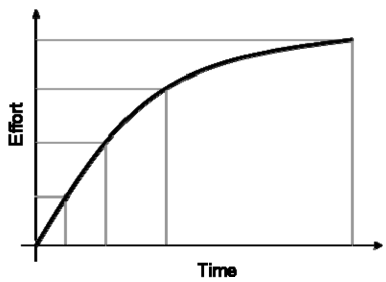


Figure 4. Typical profile of effort versus time for a single design activity

As a result we have introduced an alternative to capturing designers' views on progress: now we capture the current 'expected completion date' of the activity and we then infer the duration progress on that basis:

$$\text{Duration \%} = (\text{Current Date} - \text{Start Date}) / (\text{Expected Completion Date} - \text{Start Date}) \qquad (1)$$

This can then give results which look peculiar to the untrained eye. For example, an activity which was due to start on 1st February 2010 and has a target duration of 10 days is due to finish on 12th February 2010 (assuming a five day working week). Then, if at the mid-point (end of 5th February), the activity is recorded by the designer as 75% complete (by which they mean that have expended 75% of the effort) but is also predicted by a designer to finish on 26th February, a duration progress will be inferred of:

$$\begin{aligned} \textit{Duration \%} &= (5^{th} - 1^{st}) / (26^{th} - 1^{st}) \\ &= 5 \text{ working days} / 20 \text{ working days} \\ &= 25\% \end{aligned} \quad (2)$$

This difference between effort progress (for example 75%) and duration progress (25%) can be disillusioning for designers if they do not understand the difference. However, we have seen that it is possible to clarify the differences by circulating definitions of progress duration and that this means of capturing progress gives an accurate overall picture of a project that would, otherwise, not be possible to achieve.

4 CONCLUSIONS

ADePT has been widely used as a scheduling and planning tool over many years. In recent years it has also been used as a management tool. As the technique has been implemented on more-and-more projects, more has been established about the reality of designers' behaviour in those projects. We have seen how the efficient processes established in a DSM can be undermined by designers' traditional methods and that traditional progress reporting can give a false understanding of the overall progress in a project. The ADePT software tools have been amended to incorporate simple features aimed at encouraging changes towards more effective and efficient practices.

REFERENCES

APM (2002), *Earned Value Management: APM Guidelines,* Association of Project Management, ISBN: 978-1-903494-26-4.

Austin, S.A., Baldwin, A.N., Li, B., & Waskett, P.R. (1999a). Analytical Design Planning Technique: a model of the detailed building design process. *Design Studies, 20 (3)*, pp. 279-296.

Austin, S.A., Baldwin, A.N., Li, B., & Waskett, P.R. (1999b). Analytical Design Planning for Technique (ADePT): programming the building design process. *Proceedings of ICE, Structures and Buildings, 134*, 111-118.

Austin, S.A., Baldwin, A.N., Li, B., & Waskett, P.R. (2000). Analytical design planning technique (ADePT): a dependency structure matrix tool to schedule the building design process. *Construction Management and Economics, 18(2)*, 173-182.

Meredith, J.R. & Mantel, S.J. (2009). *Project Management: A Managerial Approach*, 7th Edition, Wiley, ISBN: 978-0-470-22621-6.

Newton, A.J., Steele, J.L., Austin, S.A., & Waskett, P.R. (2007). Benefits derived from use of DSM as part of the ADePT approach to managing engineering projects. *Proceedings of the 9th International Design Structure Matrix Conference, DSM'07*, 16th-18th October 2007, Munich, Germany.

Waskett, P.R., Newton, A.J., & Steele, J.L. (2005). Implementing DSM in a large fragmented engineering project team. *Proceedings of the 7th International Dependency Structure Matrix (DSM) Conference, DSM'05*, October 4-6, 2005, Seattle, Washington, USA.

Contact: P. R Waskett
Adept Management Ltd
The TechnoCentre
Puma Way, Coventry
United Kingdom
Tel: +44 (0)24 7623 6929
Fax: +44 (0)24 7623 6930
e-mail: paul.waskett@adeptmanagement.com
URL: www.adeptmanagement.com

Practical Ways of Dealing with Progress in a DSM Tool

Paul Waskett[1]
Andrew Newton[1]
John Steele[2]
Jamie Hammond[2]

[1]Adept Management Ltd, Coventry, UK
[2]AML Technologies, Carlsbad CA, US

Technische Universität München

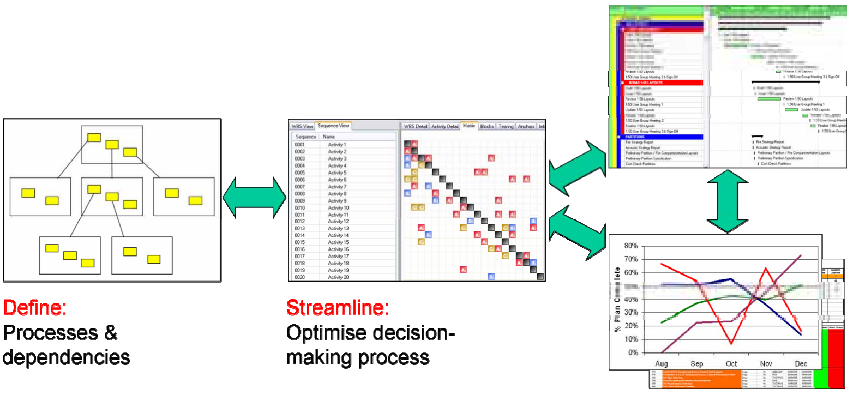
UNIVERSITY OF CAMBRIDGE

adept management ltd

Index

- What is 'ADePT'
- Process control: measurement and reporting
- 'Out-of-sequence' progress
- What does 80% mean?

Overview of the ADePT methodology



Define: Processes & dependencies

Streamline: Optimise decision-making process

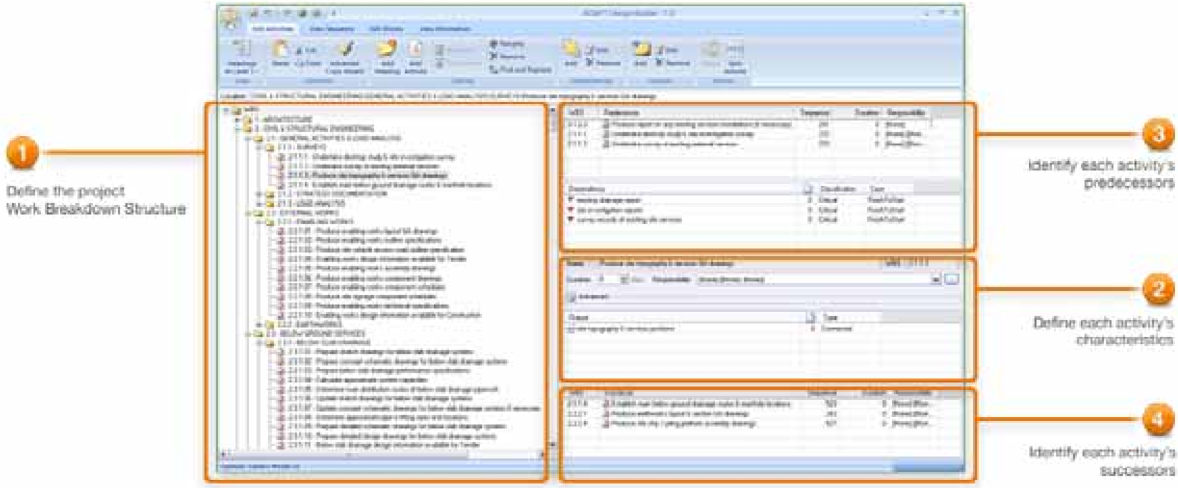
Plan: Project & discipline schedules

Deliver: Management & reporting

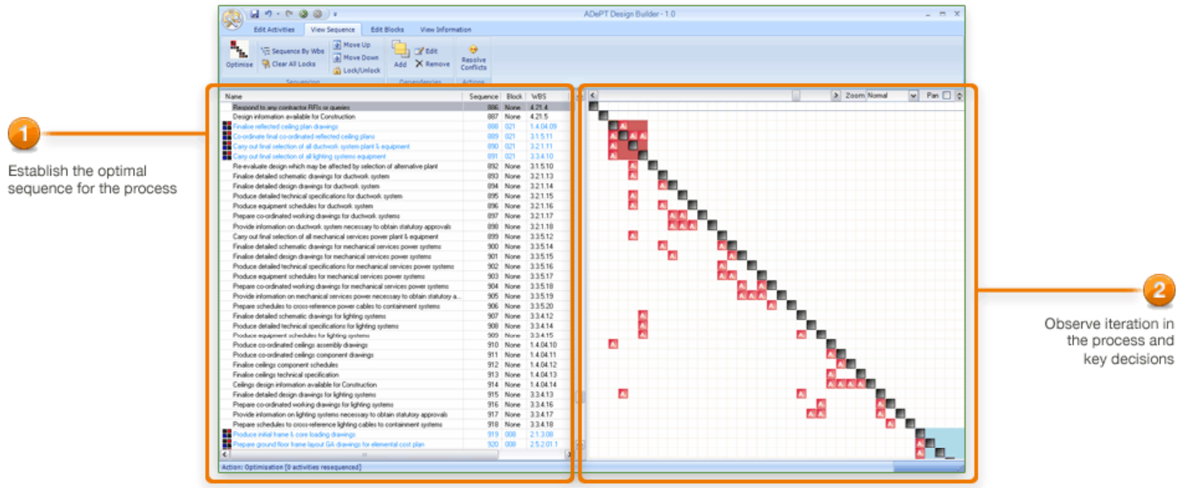
Characteristics of ADePT

- WBS
- Dependencies
- Dependency strength (3-point scale)
- Partitioning (sequencing) algorithm
- Tearing algorithm
- 2-way interface with commonly used scheduling tools inc. MS Project & Oracle Primavera

The process modelling component of ADePT



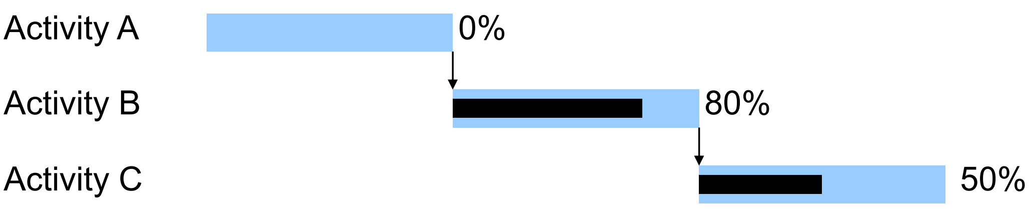
The DSM component within ADePT



Capturing progress

				Workplan start date:	06 Feb 2010						
				Focus period end date:	05 Mar 2010						
				Look-ahead period end date:	05 Mar 2010						
WBS	Activity Name	Responsibility	Start	Finish	Activity Priority	Current % Complete	New % Complete	Change in %	Expected End Date	Reason for Failure / Constraint	General Comments
01 - BELMARSH SITE WIDE DESIGN											
01.1.1 - MASTER PLANNING & SITE LAYOUTS											
01.1.1.2 - MASTER PLANNING & SITE LAYOUTS FOR REVIEW											
01.1.1.2.1	BM - SW - Finalise co-ordinated site plan layout	Architecture	23 Feb 2010	08 Mar 2010	B - Due to be progressed	0	95	95		Awaiting Contractor Decision	Waiting response to drawings issued for comment(see RFI's
01.1.4 - INTERNAL SECURITY FENCING											
01.1.4.1 - INTERNAL SECURITY FENCING LAYOUTS FOR COMMENT											
01.1.4.1.2	BM - SW - Prepare initial internal security fencing details & elevations	Architecture	07 Dec 2009	18 Dec 2009	A* - Late	0	0	0		Design not in scope or responsibilities	This work carried out by Specialist Contractor
01.1.4.2 - INTERNAL SECURITY FENCING LAYOUTS FOR REVIEW											
01.1.4.2.1	BM - SW - Finalise internal security fencing layouts and sections	Architecture	26 Jan 2010	01 Feb 2010	A* - Late	0	75	75		Awaiting Contractor Decision	Awaiting response to drawings issued for comment
01.1.4.2.2	BM - SW - Finalise internal security fencing details & elevations	Architecture	26 Jan 2010	01 Feb 2010	A* - Late	0	0	0		Design not in scope or responsibilities	This work carried out by Specialist Contractor
01.1.4.2.3	BM - SW- Internal security fencing information available for review	Architecture	01 Feb 2010	01 Feb 2010	A* - Late	0	75	75		Awaiting Contractor Decision	Awaiting response to drawings issued for comment
01.1.4.2.4	BM - SW- Internal security fencing information available for construction	Architecture	15 Feb 2010	15 Feb 2010	A - Due to be completed	0	75	75		Awaiting Contractor Decision	Awaiting response to drawings issued for comment
01.2.6 - HARD LANDSCAPING											
01.2.6.1 - HARD LANDSCAPING DESIGN FOR COMMENT											
01.2.6.1.6	BM - SW - Produce initial building access ramps details	Architecture	26 Jan 2010	22 Feb 2010	A - Due to be completed	10	100	90		Awaiting Contractor Decision	Identified on elevation dwgs issued for comment (see RFI's
02 - BELMARSH LIVING UNIT											
02.1.1 - DESIGN DEVELOPMENT TO ISSUE INITIAL 3D MODEL											
02.1.1.1 - 1:200 BUILDING LAYOUTS											
02.1.1.1.3 FINALISE 1:200 LAYOUTS & INITIAL 3D MODEL											
02.1.1.1.3.5	BM - Living Unit - Issue 3D Model of cores at 1:200 sign off to rest of team	Architecture	16 Dec 2009	16 Dec 2009	A* - Late	95	100	5		Awaiting client sign off	Issued 10/02/10
02.1.1.1.3.6	BM - Living Unit - 3D Model co-ordinated with structures and services requirements	Architecture	16 Dec 2009	16 Dec 2009	A* - Late	0	90	90		Awaiting design information	M+E design / Structural columns locations undergoing revi
02.1.1.2 - SHELL & CORE											
02.1.1.2.02	BM - Living Unit - Confirm window & façade feature positions (louvres, grilles etc.)	Architecture	20 Oct 2009	18 Dec 2009	A* - Late	95	95	0		Awaiting design information	M+E info awaited following Co-ord meeting 09/02/10
02.1.1.2.05	BM - Living Unit - Confirm position of major openings & elements on roof (rooflight:	Architecture	20 Oct 2009	02 Nov 2009	A* - Late	50	50	0		Awaiting Contractor Decision	M+E info/Rooflight manufacturer awaited as co-ord mtg 0
02.1.1.2.07	BM - Living Unit - Finalise Roof layout for SERCO Sign Off	Architecture	03 Nov 2009	30 Nov 2009	A* - Late	0	0	0		Awaiting design information	M+E info awaited following Co-ord meeting 09/02/10
02.1.1.2.08	BM - Living Unit - Finalise Elevations for SERCO Sign Off	Architecture	03 Nov 2009	30 Nov 2009	A* - Late	0	0	0		Awaiting Contractor Decision	M+E info/Rooflight manufacturer awaited as co-ord mtg 0
02.1.2 - 1:50 BUILDING LAYOUTS											
02.1.2.2 - 1:50 INDIVIDUAL ROOM LAYOUTS											
02.1.2.2.1 - FIRST ITERATION OF OF 1:50 ROOM LAYOUTS TO WINGS											
02.1.2.2.1.3	BM - Living Unit - First Iteration of all necessary room elevations in wings	Architecture	17 Dec 2009	07 Jan 2010	A* - Late	0	75	75	12 Mar 2010	Awaiting Contractor Decision	Awaiting outstanding FF+E info from Contractor - RFI issue
02.1.2.2.2 - SECOND ITERATION OF OF 1:50 ROOM LAYOUTS TO WINGS											
02.1.2.2.2.1	BM - Living Unit - Second Iteration of FF & E layouts for rooms to wings	Architecture	15 Jan 2010	28 Jan 2010	A* - Late	0	10	10		Awaiting Contractor Decision	Awaiting outstanding FF+E info from Contractor - RFI issue

‘Out-of-sequence’ progress

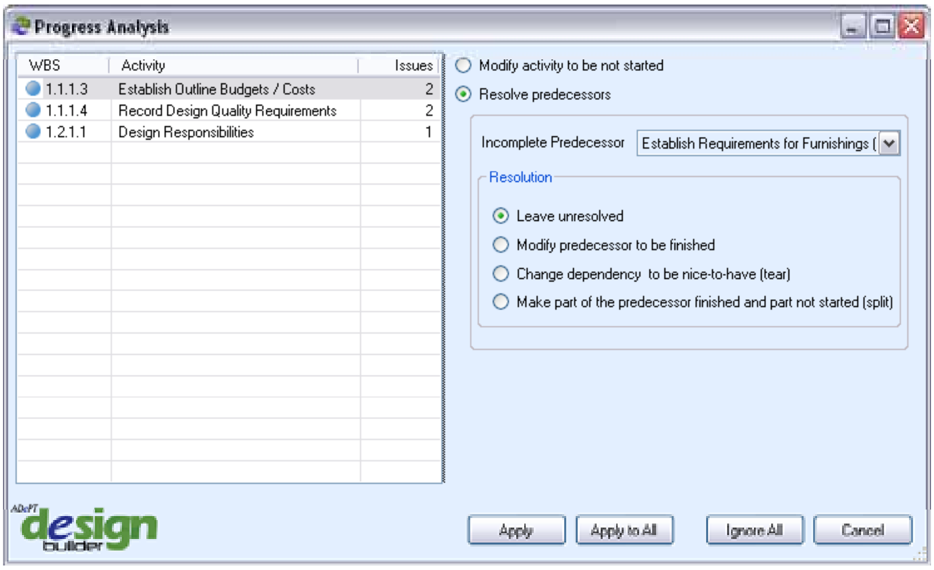


Implications – four possibilities

- An activity recorded as progressed is in fact not started
- The preceding activity is recorded as incomplete but is in fact fully complete
- The progressed activity is no longer dependent on the preceding activity: a tear has been made
- Enough of the preceding activity has been completed to generate an output which has enabled the following activity to commence: the predecessor activity is poorly defined

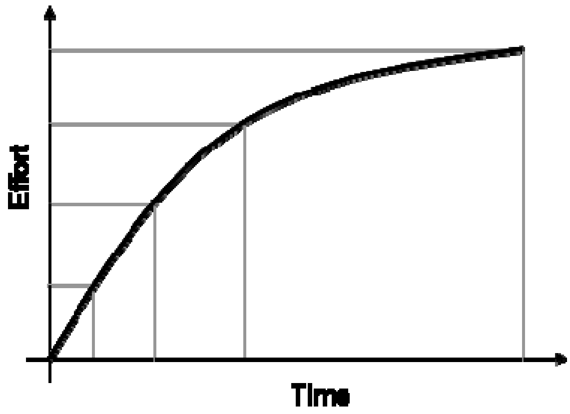
BY MODELLING DEPENDENCIES
MANAGING COMPLEXITY
adept management ltd

Implications – four possibilities



Design progress: effort v duration

- What should be measured?
  - Time
  - Effort
  - Physical outcome



MANAGING COMPLEXITY
BY MODELLING DEPENDENCIES
adept management ltd

Duration progress

- Duration % has nothing to do with Effort %
- Duration % =
  (Current Date–Start Date)/(Expected Completion Date–Start Date)
- A 10 day activity (target duration) which we believe will be finished six weeks from now has an actual duration of 30 days
- Designers and engineers struggle to appreciate the difference between time and effort: when quoting progress they usually mean effort, but their schedules are usually interested in time.

Physical progress in design

- The outcome of a design activity is information
- Only when the activity is completed is the information reliable
- Information may appear reliable before the activity is complete, but commencing dependent activities represents a risk

MANAGING COMPLEXITY
BY MODELLING DEPENDENCIES
adept management ltd

Overall progress / project status report