Project Services Pty Ltd

IMPROVING SCHEDULE MANAGEMENT

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Patrick Weaver PMP, FAICD, FCIOB,
Director, Mosaic Project Services Pty Ltd

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Mosaic Project Services Pty Ltd
PO Box 5150
South Melbourne VIC 3205 Australia
Tel: +613 9696 8684
Email: Info@mosaicprojects.com.au
Web: www.mosaicprojects.com.au

Introduction

Modern project management grew out of the ideas of Scientific Management. Its concepts of command and control and predictability are firmly embedded within the traditional philosophical underpinnings of the practice. However, the emergence of knowledge workers and 'soft' projects is challenging the validity of these concepts. In response to the complex and dynamic nature of modern business projects new project management paradigms are emerging based on complexity theory and social network theory. This paper explores these emerging ideas and defines a new role for the project schedule and the project scheduler within the complex, dynamic, collaborative environment that defines many of today's projects and programs.

To contribute value in this newly emerging paradigm, the schedule must stop posing as an accurate prediction of the future that is capable of controlling future performance (if this was ever possible) and become a dynamic tool used for communication, coordination and motivation. The key element needed to achieve this change is for all stakeholders to acknowledge the imprecise nature of any prediction about what may happen in the future. This acknowledgement allows critical questions about the extent of error in a schedule to be asked, systems implemented to manage the inevitable inaccuracies, and the resulting information to be used to proactively influence the future direction of work on the project.

This paper opens with a review of the current state of play including a brief review of scheduling standards and credentials; it then contrasts the traditional view of project controls with some of the emerging views of projects as social networks operating within a complex system. The final section focuses on schedule management in the 21st century and the attributes of a 'good' schedule and a 'good' scheduler in a complex project environment. In closing the paper highlights some of the ways an effective 21st century scheduler can contribute to the success of a project.

The Current State of Play

Project Management grew out of the ideas of Scientific Management and these theories underpin much of modern project management's processes and practices, in particular scheduling (Weaver 2007). Two of the key ideas from scientific management are:

- The concept of reductionism – you can understand how a whole system works by examining its parts. If understanding and control cannot be achieved at the current level of detail, break the object into smaller parts to achieve a greater level of insight – ie, add more detail.
- The Newtonian view of the world as a predictable clockwork mechanism where inputs have predictable, linear outputs. This concept is central to the traditional views of scheduling and resource planning.

However, the emergence of the knowledge worker and 'soft' projects is challenging the concepts of command and control derived from Scientific Management. Modern business projects are complex and dynamic; new paradigms are emerging based on complexity theory and social network theory; and these ideas challenge the traditional role of project control tools such as the contract schedule.

Evolving Scheduling Standards

The practice of scheduling has fluctuated over the years[1]. From a low point in the 1990s, there has been an increasing focus on the codification and standardisation of scheduling and the creation of credentials for schedulers. Some of the new and updated documents from PMI and the United Kingdom that the author has had an involvement in are outlined below.

[1] See: A Brief History of Scheduling - Back to the Future. https://mosaicprojects.com.au/PMKI-ZSY-020.php#Overview

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PMBOK® Guide

Scheduling has always been a key Knowledge Area in the Project Management Institute's (PMI®) core publication, *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*. Its definition of 'time management' has remained basically unaltered since the initial publication in 1983. Apart from renaming its Time Management processes to a consistent 'verb-noun format', the only significant change between the *PMBOK® Guide* 3rd and 4th Editions has been the removal of the Arrow Diagramming Method (PMI, 2008).

From the scheduling perspective, the most significant change between the Editions is a general shift in emphasis from the idea of controlling stakeholders to a more realistic idea of managing stakeholders – whilst not changing the processes needed to create a schedule, this idea dramatically changes the **use** of the schedule.

PMI's *Practice Standard for Scheduling*

The publication by PMI of *The Practice Standard for Scheduling* (PMI, 2007) expanded on the structural framework of the *PMBOK® Guide* to develop a strong technical underpinning for the practice of scheduling. However, Chapter 5 provides a framework for measuring the technical conformance of a schedule the standard acknowledges there is a long way to go to achieve a simple understanding of what makes a 'useful' and 'useable' schedule.

The PMI CoS, Scheduling Excellence Initiative

Within PMI, the College of Scheduling (CoS) is developing the Scheduling Excellence Initiative (SEI). SEI is currently focused on developing and publishing the *Best Practices Guideline Series* – a multi-volume reference centre for scheduling concepts methodologies and best practices.

The APM *Introduction to Project Planning*

The Association for Project Management (APM) in the UK has also been busy. The APM Planning Special Interest Group has recently published its *Introduction to Project Planning* (APM, 2008). This guide focuses on practical planning issues with its core chapters framed on the questions 'why?', 'when?', 'who?' and 'how?'.

CIOB: *The CIOB Guide to Good Practice in Project Scheduling*

Still in development, *The CIOB Guide to Good Practice in Project Scheduling* is focused on scheduling practice associated with major construction and engineering projects. For more information see http://www.mosaicprojects.com.au/Training-CIOB-TM_Credential.html.

Scheduling Credentials

Currently there are two scheduling credentials from internationally recognised associations (as far as I am aware, as at December 2008 - although I expect this number to rise). Unfortunately, both of these credentials are aimed at very senior schedulers and there are no internationally based credentials available for people wishing to move into the discipline. As a consequence, junior schedulers either learn from experienced schedulers, via some form of unofficial 'apprenticeship', or more frequently simply by trial and error and possibly a short software course. This early focus on scheduling software rather then scheduling practice is highly detrimental as will be demonstrated later in this paper. The two currently available credentials are from AACE and PMI:

AACE, Planning & Scheduling Professional (PSP)

The Association for the Advancement of Cost Engineering International (AACE) PSP credential has been available for a number of years. It is aimed at senior schedulers in the construction and engineering industries with at least 8 full years of professional experience (4 years with a recognised

construction / engineering degree). The exam is an 8 Hr marathon. For additional information see: http://www.aacei.org/certification/PSP/welcome.shtml

PMI-SP Credential

The PMI Scheduling Professional (PMI-SP) credential was launched in 2008. The credential is aimed as project schedulers from all industries. The credential requires between 3 and 5 years of scheduling experience to be eligible to sit for the exam. For additional information see: http://www.pmi.org/CareerDevelopment/Pages/AboutCredentialsPMI-SP.aspx

State of Play - Conclusion

The current 'state of play' is a significant improvement from a few years ago. However, it is still the case that very few of the total number of projects world-wide benefit from the services of a skilled scheduler, assisting the project manager and project team deliver successful projects. The primary cause of this situation is a world-wide shortage of skilled schedulers. Consequently, whilst there is an increasing awareness of the potential value to be gained from effective scheduling in some quarters, many project managers and organisations don't even realise what they are missing!

In response to this situation, institutions world-wide are starting to focus on developing guidelines and standards for scheduling that are generally consistent. What's missing is a uniformly recognised training framework and career path for schedulers, particularly in the formative years of their careers. Hopefully now there are recognised guidelines published in a range of guides and practice standards the gaps at the lower end of credentialing framework will be filled by various institutions, including PMI.

Probably the most significant change in the last decade is the emerging realisation that being a 'good' scheduler involves much more than simply being a proficient 'software jockey', irrespective of the sophistication of the scheduling tool being used. Unfortunately, the lack of authoritative guides and standards over the last few decades and the consequential lack of understanding of scheduling (as opposed to the use of scheduling software) has lead to many organisations to believe being a highly skilled 'software jockey' is synonymous with being a highly skilled scheduler. Their determinant of 'scheduling seniority' is based on the knowledge of the features in the organisation's scheduling tool of choice and they expect their schedulers to generate massive multi-thousand activity schedules. These same organisations rarely see much value from the scheduling process, the scheduler is rarely consulted about current and future options for the project and the primary use of the schedule and its embedded data is for identifying delays (after the event) and contractual claims.

Effective scheduling is altogether different – it's focused on influencing the future; after all, the future is the only thing you can influence and possibly change! A highly effective scheduler will still be at least proficient (and preferably highly skilled) in the use of the organisation's scheduling tools but the measure of his/her success is not the size of the schedule (or its level of detail), rather how well the schedule is used to inform management decisions on an hour-by-hour basis and the degree of influence the schedule has on the future conduct of the project.

The Traditional View of Project Controls

The Newtonian / Scientific Management view of the world suggests that understanding a complicated entity can be achieved by taking it to bits and studying the parts. Once understanding has been achieved, and because for every action, there is a predictable and equal reaction, a sufficiently developed schedule model should be capable of accurately predicting the future. When the predictions fail to materialise, more investigation is needed; from a scheduling perspective, this translates to the assumption that accuracy is increased by adding detail.

This foundation then allows the assumption that a well developed schedule can, with proper supervision, control workers' actions. The ultimate expression of these ideas is embedded in the legal view of the contract schedule. A contract schedule is assumed by law to represent the way the contract will be executed by the contractor. Some schedule clauses in contracts actually prohibit the modification of the schedule or make the process of changing the schedule difficult.

Some of the problems with this line of reasoning are bullet pointed below:

- To quote the late Douglas Adams *"I can imagine Newton sitting down and working out his laws of motion and figuring out the way the Universe works and with him, a cat wandering around. The reason we had no idea how cats worked was because, since Newton, we had proceeded by the very simple principle that essentially, to see how things work, we took them apart. If you try and take a cat apart to see how it works, the first thing you have in your hands is a non-working cat."* (Adams, 1998). The way complex entities work cannot be understood by breaking them down into parts. Even at the simplest level, studying a fish cannot explain how a shoal of fish work; at a complex level understanding a project task in isolation will not explain the dynamics of a major project and its team of resources.
- If the future was predictable, there would be no need to lose money during stock market crashes and bookmakers would be extinct. The inherent uncertainty about predicting the future has been understood for at least 300 years! As Leibniz wrote in a letter to Bernoulli in 1703 "Nature has established patterns originating in the return of events, **but only for the most part**" (Bernstein, 1996). In summary, the past is a useful guide to what may happen in the future but there are no guarantees[2].
- The paradox of knowledge workers! Scientific management produced huge productivity gains through the first part of the 20th century. Its focus was on the worker as a part of the productive machinery of business (exemplified by Henry Ford's production line) and discovering the 'right way' of accomplishing each task to maximise efficiency. These ideas worked well for repetitive manual tasks that typified manufacturing through to the 1960s. Problems with the scientific view of management quickly surfaced as the nature of work changed from making tangible things to creating knowledge (eg, writing software).

  Consider the software engineer tasked with developing an algorithm to solve a data transcription problem. The primary work is thinking through the problem and creating the idea that will allow its solution. This happens in the engineer's mind. Counting outputs is useless, the number of lines of code written do not measure the effectiveness of the solution; the most efficient and elegant solution may have far fewer lines of code than some inefficient clunky solution. Furthermore, the effectiveness (quality) of the solution cannot be fully tested until several other components are developed (by other people) and integrated, potentially requiring changes in our engineer's algorithm. The only person that can actually control the work is the knowledge worker and he/she needs to be continually coordinating his/her work with the work of other knowledge workers in the team. The need for a new paradigm to manage knowledge workers was identified as early as 1954 by Peter Drucker (1954) and expanded upon in his later books.

Even the concept of project controls is a misnomer; a control system must by definition control something! The steering mechanism on your car controls the position and action of the front wheels – turning the steering wheel causes the position of the wheels to change in proportion to the degree of movement on the steering wheel and, in normal circumstances, the direction of travel of the car changes in a predictable way in response to the steering command. Other factors such as excessive speed or slippery road surfaces may cause unexpected effects from the steering change but if you turn the steering wheel on a moving car, you can definitely expect a consequence.

[2] See: *The Meaning of Risk in an Uncertain World.*
https://mosaicprojects.com.au/PDF_Papers/P040_The_Meaning_of_Risk_in_an_Uncertain_World.pdf

Despite conventional wisdom and current naming conventions, none of the so-called project control tools actually control anything. Changing numbers in a cost plan will not influence the movement of money into or out of an organisation's bank account – people writing cheques or processing funds transfers do that. Similarly changing the duration of a scheduled activity has absolutely no effect on the time the work actually takes to perform. The most these project control tools can achieve is to influence the thinking of workers in a way that may change their future actions. Nothing can change what's already happened!

Additionally, from a controls perspective, there is a major difference between time and money. If you do not spend money today, it remains in the organisation's bank account to be spent tomorrow. If you do not use time efficiently today, it is gone forever – time moves from the present to the past at a rate of 60 seconds per minute, every minute of the day and nothing can control this! Consequently, the value of project schedule is not and never has been as a control tool! The value of a useful schedule created by a skilled scheduler lies in a completely different direction as discussed below.

Some Emerging Views of Projects

Chaos Theory and Complexity

Complexity theory has become a broad platform for the investigation of complex interdisciplinary situations. It developed from and includes the earlier field of study known as chaos theory and can be defined as the study of how order and patterns arise from apparently chaotic systems, and conversely, how complex behaviour and structures emerge from simple underlying rules (Cook-Davies, et al, 2007).

Projects are described as chaordic, a system that blends characteristics of apparent order at the macro level with chaos or uncontrollability at the detail level (Woolf, 2007). Within a chaordic system, responses to stimuli tend to be nonlinear (small changes in the stimuli can cause major changes in the resulting action; and the reverse is also true).

Another phenomenon is called the 'Tipping Point' (Gladwell, 2000) where one small additional stimulus can cause a catastrophic and non-reversible change in the whole system (ie, 'the straw that broke the camel's back').

In summary, complexity theory suggests that in a complex system, the result of an action is not predictable! Despite this lack of predictability, the theory explains self-organising systems (complex dynamical systems that are capable of self-organisation). At the simple level there are shoals of fish and flocks of birds, at a more sophisticated level, groups of people. Self organising systems are built from a set of simple rules, contain feedback loops that can amplify or attenuate the effect of stimuli and are capable of learning from and adapting to their changing environment. In many respects this describes the operation of a project team[3].

Projects as Temporary Knowledge Organisations (TKOs) & Social Networks

Viewing a project as a temporary knowledge organisation (TKO) moves the focus of project management from the observation of the output of the project (its deliverable) to managing the processes needed to transform inputs received by the project team into the project deliverable(s). This is achieved by the gathering, melding, processing, creating and using of knowledge. The distinguishing factor that separates projects from operational work is not the temporary nature of the 'endeavour' (all endeavours are temporary), but the temporary nature of the project team brought

[3] See: *A Simple View of 'Complexity' in Project Management.*
https://mosaicprojects.com.au/PDF_Papers/P070_A_Simple_View_of_Complexity.pdf

together to execute the project and then dissipated on the completion of the project's deliverables. Operational teams are managed on the assumption they are relatively permanent (Sbarcea et al, 2003).

Another view of the project team is as a social network. A social network is a social structure made of nodes (which are generally individuals or organizations) that are joined by some form of relationship. Each network contains a level of 'social capital'. This is the sum of the actual and potential resources embedded within, available through, and/or derived from the network. In the context of this paper, the two key aspects of social capital are the 'know how' required to create and deliver the project outcome and the 'willingness' to exert effort to achieve the project outcome. The amount of 'social capital' within the network is heavily influenced by the strength and effectiveness of the relationships within and between the people in the project team (Brookes et al, 2006).

From complexity theory, the 'Complex Responsive Processes of Relating' (CRPR) emphasises the importance of interactions within relationships. *'Organisation is an emergent property of many individual human beings interacting together through their complex responsive processes of relating'* (Stacey, 2003). They use language in conversations to simultaneously transfer information and ideas, negotiate social status and develop power relationships. Consequently the process of 'organising' is the human experience emerging from the interactions between people within a network who are all continual forming intentions, choosing and acting in relation to each other as they go about their daily work together implementing the project (Cook-Davies, et al, 2007).

These three ideas come from different branches of research but seem to reach a common conclusion. The driving force within a project team is the intentions and actions of the people making up the team, working with each other through their personal relationships to create and use the knowledge necessary to make the unique project deliverable. Seen from this perspective the future of the project is under perpetual construction by the movement of the human action itself. The people, their interactions and the emerging organisation are located in a specific context (the organisation's social network, culture and at a more detailed level, the project team) and are oriented towards creating a desired future (the project outcome) that the group is in the process of continually creating (or working to achieve).

Risk and uncertainty are inherent in this construct – it is impossible to see inside peoples minds to fully understand their intentions and without this information it is impossible to accurately predict the future. However, it is possible to influence people's thinking through effective communication, and a good leader can motivate and inspire the team's actions.

The Role of Schedules within the Emerging View of Projects

As soon as the idea of the schedule as an accurate control tool is abandoned, paradoxically, the schedule can become an extremely useful management tool. In a 'complex world' the schedule can be used as:

- An effective planning tool to help people engage in conversations focused on optimising future actions;
- As a motivator to inspire the performance of team members;
- As an effective communication tool to coordinate actions and assist proactive collaboration[4].

To succeed in this role, the schedule needs to be flexible, dynamic, responsive and easy for the team members to understand (ie, both useful and used). And the scheduler needs to be a great communicator, questioner, listener and above all, a team player.

[4] See: *Project Controls in the C21: What works / What's fiction.*
https://mosaicprojects.com.au/PDF_Papers/P083_Project_Controls_in_the_C21.pdf

Key Focuses for Schedule Management

In the 21st century, the key focus of effective schedule management should be to assist project managers (and project teams) to deliver successful project outcomes. If the project is a success, there will be little need for the detailed 'as built' schedules used in litigation and arbitration.

The major challenge facing scheduling is to convince all of the parties to a project/contract that every schedule is inevitably inaccurate. A critical path schedule is a simplified model that outlines one option for completing the work of the project. But, *'All models are wrong, some are useful!'* (Box, 1987). Even with the full cooperation of the project team, activity duration estimating is an educated guess about what might happen in the future (Weaver, 2006a) and the CPM construct is a gross simplification of the myriad of possible interactions between scheduled activities (Weaver, 2006b). Even the calculation of elapsed task durations, start and finish dates are variable in all but the simplest of schedule networks depends on the scheduling tool used and the preferences of the scheduler[5].

These inherent characteristics of the CPM modelling process represent a major issue if people around the project expect a precisely accurate statement of the future. They are irrelevant if the same people accept, to paraphrase George Box, *'every schedule is wrong, some are useful'* and they work collaboratively to create a useful project management tool.

Another version of the Box quotation is *"all models are wrong; the practical question is how wrong do they have to be to not be useful?"* (Box, 1987) Accepting the fact that the schedule cannot be 100% correct does not remove the challenge of making it as realistically accurate as possible. The past is still a guide to the future and whilst committed team members may not deliver on their commitments at some point in the future, the schedule needs to represent the project team's best intentions and expectations 'at this point in time' if it is to be seen to be seen to be realistic and achievable. Only after the schedule has crossed this first hurdle and is accepted by the project team as 'realistic and achievable' can it start to be useful. In this regard, the key characteristic of a 'useful schedule' is that is it used by the Project Manager and project team to manage the execution of the project work in a proactive and collaborative way. In short, **useful schedules are 'useful' because they are used!**

Attributes of a 'Good' Schedule – The document

Chapter 3 of *The Practice Standard for Scheduling* (PMI, 2007) contains an outline of good scheduling practice needed to create and maintain a 'good schedule'. Some of the key elements are:

- **Understanding the purpose of the Project Schedule.** In general terms, the purpose of the project schedule is to provide a useful 'road map' that can be used by the project manager and the project team to assist them in completing the project successfully. However, the sort of schedule that is appropriate for use in the early stages of a major project when its overall feasibility is being established is different from the sort of schedule needed to coordinate the work in a major plant room[6].
- **Designing the Project Schedule.** Once the purpose of the particular schedule is understood, the scheduler can design an appropriate framework taking into account such factors as the level of detail needed, the update cycle, reporting and communication requirements (these influence coding structures)[7].
- **Developing the scheduling framework.** The critical element in developing a useful schedule is engaging the key members of the project team in the process; the schedule must be 'owned' by the project manager and project team if it is going to be useful.

[5] See: *Links, Lags & Ladders*. https://mosaicprojects.com.au/PDF-Gen/Links_Lags_Ladders.pdf

[6] For additional information see: *Schedule Levels*. https://mosaicprojects.com.au/PDF-Gen/Schedule_Levels.pdf

[7] See: *A Guide to Scheduling Good Practice*. https://mosaicprojects.com.au/PDF-Gen/Good_Scheduling_Practice.pdf

- **Developing the Baseline schedule.** Transitioning the schedule from the agreed team document to the official project baseline involves two phases. The first is essentially 'housekeeping' where the scheduler checks and validates the schedule is complete, it meets all of the project objectives, is correctly coded, etc. Probably the most important check is to ensure the schedule is dynamic[8]; with all activities properly linked and all unnecessary constraints removed. The second phase is obtaining approvals and sign off on the schedule from all of the appropriate stakeholders.
- **Maintaining the schedule.** The process that keeps a project schedule 'useful' is the regular statusing and updating of the schedule[9] and the management of schedule changes through the project's change control process.

Some of the major damaging influences that destroy the usefulness of the schedule are:

1. Making a detailed schedule into a contract document. This distorts the schedule as parties manipulate data to political ends.
2. Excessive detail - Schedules should have adequate detail for a collaborative coordinated approach to managing the project. Excessive detail:
   - Hides useful information and slows information flows
   - Prevents the easy testing of ideas by 'what if' changes
   - At best shows where people are failing to meet the program (even if it is wrong)
   - Does not improve accuracy (Weaver, 2006b)
3. Promising the Impossible! Scheduling has been sold as:
   - A control tool – but nothing written on paper will control the future
   - A precise statement of fact - the contract program
   - As having accurately calculated durations

   none of these assertions are true and when the schedule fails to deliver the loss of credibility destroys the useful aspects of a schedule as well as the unrealistic expectations.

A good schedule is easy to use, it contains just enough detail for the coordination of the work in a collaborative environment, it's dynamic and it's easy to update and maintain. The key measure of a scheduler's success in creating a 'good' schedule is its regular use by the project manager and project team to assist in their day-to-day decision making. This is best achieved by making sure the schedule reports are simple, clear and concise with the right information being conveyed to the right team members and by the project scheduler being easily accessible to help with communication, interpretation and understanding.

Attributes of an Effective Scheduler – The person

The roles fulfilled by a scheduler change as the project progresses through its life cycle from a concept, to a definite 'job', to a 'work in progress'[10]. The three phases are:

- **Pre-initiation (commitment / feasibility planning).** During this phase information is scarce, the scheduler works with the project team to 'paint a time picture' of the project, to develop a strategy for delivery and gain consensus. Generally the scheduler is the key time management expert and frequently a product expert drawing on previous experience to fill in gaps in the overall project information. This is an artistic and creative role focused on 'what might be';
- **Initiation and Planning (execution scheduling).** The scheduler is now in a facilitating role assembling information from the project team (and frequently sub-contractors) to develop the project schedule model and eventually the baseline schedule. The scheduler's role is to integrate and test the information for logic, common sense and completeness by asking the right questions. The information in the model must be 'owned' by the project team, but the

[8] See: *Dynamic Scheduling*. https://mosaicprojects.com.au/PDF-Gen/dynamic_scheduling.pdf

[9] See: *Managing for Success - The power of regular updates*. https://mosaicprojects.com.au/PDF_Papers/P002_MFS_Full.pdf

[10] See: *The Attributes of a Scheduler*. https://mosaicprojects.com.au/PDF-Gen/Attributes_of_a_Scheduler.pdf

scheduler remains totally responsible for the integrity of the scheduling tool and the schedule data;

- **Executing and Monitoring & Controlling (performance control).** During the execution of the project the work the scheduler moves into a support role; maintaining the schedule, testing 'what-if' scenarios, optimising change outcomes and advises the project team on performance. The scheduler should be consistently alert to identify changes, variations in scope and trends that may influence project outcomes and advise the project management team of his/her observations, findings and recommendations.

To fulfil the roles outlined above, schedulers need to be proactive and constructively inquisitive, continually seeking to understand, clarify and explain the scope of 'their project' and the dynamics of the work flow to the project team they support. They have the courage to 'paint a time picture' of the project when details are scarce or almost non-existent and then willingly update and modify their starting point as more information becomes available. As the project team members become more familiar with the project, the scheduler is happy to defer to the team member's opinions and views, acknowledging it is the project manager and project team who are responsible for delivering the project 'on schedule'.

Schedulers also need core technical skills including being:

- Good with data;
- Concise and accurate in their work;
- Capable of learning how to use a scheduling software tool

For additional information, see:

The Roles and Attributes of a Scheduler.
https://mosaicprojects.com.au/PDF-Gen/Attributes_of_a_Scheduler.pdf

Schedule Initiatives to assist Project Management:

A good scheduler will contribute to a whole range of management initiative to help make a project successful. Working in support of the project manager, the scheduler can/should:

- Facilitate and sustain the project scheduling process to the benefit of the project manager and project team.
- Work as a time budgeter making sure adequate time is allowed for all phases of the project, particularly elements that are regularly underestimated such as testing and commissioning.
- Minimise 'time risks' and contribute to the overall risk management/risk mitigation efforts of the project team by understanding the dynamics of the project.
- Optimise costs and minimise waste by balancing and smoothing resource demand, minimising relocations, avoiding call backs, etc.
- Facilitate understanding by effective communication with all of the project stakeholders. This requires concise and effective reports focused on the needs of individual stakeholders that are easily understood and acted upon. Some of the key lines of communication are:
    - Communicating with the project team to develop an agreed schedule;
    - Communicating with project stakeholders to explain the schedule;
    - Communicating with the project management team to adapt the schedule to changing circumstances;
    - Communicating with the project team through the status/update process to maintain momentum on the project.
- Keep a very close watch on the overall momentum of the project. If the overall performance intensity drops, the project will eventually lose time regardless of the progress on the critical path in the last reporting period [for more on this see 'Momentum Theory (Woolf, 2007) and Earned Schedule: www.earnedschedule.com].

- Understanding the 'spaces' – what happens in the gap created by Start-to-Start and Finish-to-Finish lags and make sure they are honoured – most project delays occur in these gaps[11], (Woolf, 2007).
- Assign and manage appropriate levels of access and control to the various schedule levels and the data in the tool (particularly if a web enabled interface to the scheduling software is available to the team). The tools and reports need to be managed at the project level, the team level and the individual resource level

In short, a 'good' scheduler should be one of the key support people assisting the project manager deliver a successful project outcome. He/she achieves this by continually observing, understanding and advising on the time related aspects of the project by understanding the implications of what's happening 'now' and what's likely to happen in the future.

Conclusions

When used as a dynamic motivational tool, focused on maintaining the momentum of work on a project the schedule has much to contribute to the overall success of 'modern project management' in the 21st century. However, a number of failed paradigms need to change:

- If the ideas of 'command and control' ever worked, they are certainly not effective in the current era. Collaborative working, motivation and leadership are the keys to success and an effective schedule is a vital tool to allow the coordination and understanding necessary for this approach to project delivery.
- Scheduling is not a computer-based skill – the tool is almost irrelevant. Effective scheduling is about effective communication. The only value in the scheduling tool is its ability to process data accurately and generate concise, easy to understand and easy to use reports.
- The idea of control is closely aligned to the idea of certainty. But the future is always uncertain! It is only after accepting that every schedule contains a degree of inaccuracy, processes can be put in place to maintain the schedule as 'the current best view of our objectives'. Then as circumstances change, the schedule will be updated to maintain its relevance and usefulness.

Useful schedules are those that are actually used! For the schedule to be useful and contribute to the project's success both the project manager and senior management need to acknowledge the value of the schedule as a coordination tool. The initial phase in achieving this is to employ an effective scheduler to develop a 'good' schedule. This takes time and resources. Once the schedule is developed and agreed then it's up to the project manager and senior management to make good use of it. The scheduler should be supportive but cannot lead the culture change needed to make the schedule matter.

The major change in scheduling through the first few years of the 21st century has been the publication of standards, practice guides, and credentials, that are beginning to define good scheduling practice. PMI has been a leader in this but is not alone. Now we have standards and guidelines, it is critical that the managers of scheduling practice and schedulers use the standards and embrace the credentialing process to lift the overall quality of scheduling. Much remains to be done in this regard, particularly in the area of entry level credentials and training[12], but a good start has been made and it's up to scheduling practitioners to make the most of this start.

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[11] See: *Links, Lags & Ladders*. https://mosaicprojects.com.au/PDF-Gen/Links_Lags_Ladders.pdf

[12] For more on self-paced scheduling training see: https://mosaicprojects.com.au/shop-easy-cpm.php

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