

This document contains an English translation of the following article:

Vanhoucke, M., 2014, "Gerenciamento Integrado de Controles De Projetos: Primeiro vem a teoria, e então a prática", Mundo Project Management, 59, 52-56

It takes three to tell a PM story: Integrated Project Management and Control

Mario Vanhoucke

Mario Vanhoucke Ghent University (Belgium), Vlerick Business School (Belgium), University College London (UK) mario.vanhoucke@ugent.be

Abstract

In this article, I give a short but complete overview of the topics discussed in my third and most recent Project Management (PM) book, and highlight the main reasons why I have written this book. The article shows that despite my two previous books, entitled "Measuring Time" and "Dynamic Scheduling", there still seems to be a need by students and professionals for further details on the Project Management domain, which has led me to the writing of this third book. The article will give an overview of the chapters of the book and the contribution to literature. Moreover, I will make references to my previous work that was used as a basis to write this book.

Keywords: project management, project control, risk analysis, earned value management

1 Introduction

As an academic, there are two main reasons why you should write a book about the topic of your interest. A first reason is research. A book can hold a summary of a research project and therefore acts as an alternative for the academic papers that are often too difficult or too specific to reach a big audience. A book, however, can hold more than one topic and therefore covers a complete research study, thereby reaching not only academics but also professionals, not only interested in the methodological details but also eager to learn more about the link between research and practice. A second reason is teaching. A book is the ideal tool to give an overview of a certain topic to your students at the universities and at the business school, in order to provide them with a manual containing your own view on your topic of interest. In the recent past. I have written two books on Project Management and Control, each belonging to one of the previously mentioned classes. The research handbook "Measuring Time" (Vanhoucke, 2010a) is clearly the summary of a big research project that has been awarded by PMI Belgium (2007) and the International Project Management Association (2008) and that has led to numerous publications in academic flagship journals. An overview of the topics discussed in this book can be found in a previous edition of the Measurable News (Vanhoucke, 2010b). The book "Dynamic Scheduling" (Vanhoucke, 2012b) is a student book that I use in almost all my PM courses, both at the universities and the business school where I teach, but also for my incompany trainings. An overview can be found in Vanhoucke (2013), also published in the Measurable News.

My believe was that, given the two available books, there was no specific reason why I should write a new book on the same PM topic in the next years that could be fundamentally different or that could serve another purpose than the two I already wrote. Until some clever students started to use these books to develop their own PM software systems in order to plan and control their own projects. I was obviously glad to hear that they learned these various PM topics in my courses, but they also told me that they sometimes missed "specific details" as well as "illustrative examples" to translate the course topics into real working PM tools and systems.

Although initially, I had no plans to write

a third book on project management and control, these remarks raised by some of my students gradually changed my mind. Even though I promised myself not to write a new book in the next coming years after the huge amount of work I had spent on the second edition of my previous book "Dynamic Scheduling", I figured out that the students had a good point. I must have thought that "all good things come in threes" when I suddenly contacted Springer again to ask whether they would be interested in another book on project management and control.

And they were... Given the positive book performance reports¹, my contact person was even more enthusiastic as I was, and I started writing, realizing that the next coming months would be just like only two years ago... eventually resulting in the third book "Integrated Project Management and Control: First Comes the Theory, then the Practice" (Vanhoucke, 2014). Apparently, it takes three books to completely tell a Project Management story.

2 The topics

The topic of this book is called Integrated Project Management and Control and refers to the management of projects through the integration of baseline scheduling, schedule risk analysis and project control. Schedule Risk Analysis (SRA) is a technique that relies on Monte Carlo simulations to generate activity duration and cost deviations from their baseline values to assess the impact of these variations on the time and cost objectives of the project. Project control is done using Earned Value Management (EVM) and Earned Schedule (ES) techniques and will be further referred to as EVM/ES systems. Both methods can be used to monitor the performance of projects in progress and to trigger corrective actions in case the project objectives are jeopardized. The baseline schedule acts as a central point of reference for both methods and is a crucial element for proper use of the EVM/ES and SRA systems. The integration between EVM/ES and SRA using baseline scheduling is referred to as dynamic scheduling (Uyttewaal, 2005; Vanhoucke, 2012b) or *integrated project management and control,* and is the topic of this book.

Figure 1 gives an overview of the structure of the book. This figure is used throughout the whole book to show the links between the various chapters and is made to refer to the three previously mentioned techniques of Integrated Project Management and Control. Obviously, the most important chapter of the book is chapter 7, which is put in the middle of the figure and contains the title of the book. However, before the book comes to the discussion of this chapter, the elements three crucial as previously mentioned (baseline scheduling, risk analysis and project control) must be discussed, as follows:

- Baseline schedule: In this book, the construction of the baseline schedule is assumed to be a given and is kept fairly simple. Although this step is crucial for the two other steps, it is not the main topic of this book, and it is therefore not included in the figure. However, in order to fully understand all calculations made in the book, the assumed project data and baseline schedule information is described in the first chapter of the book.
- The Schedule Risk Analysis techniques, displayed at the bottom part of the figure, below the central block containing the book title, are discussed in chapter 6.
- The Project Control techniques, including EVM and ES, are displayed in the upper part of the figure and discussed in chapters 2 to 5 of the book.

The book is fairly small and quite dense (only 141 pages). Each page contains mathematical equations and/or calculations, and a short overview of the various chapters is discussed along the following sections. The book consists of two parts. The first part mainly focuses on the data and the calculations, illustrated by PM overview reports, and intends to give a full overview of the metrics and measures available in literature. The second part puts a focus on the use of the material presented in part 1 using two software tools, hereby focusing on students, professional users as well as on researchers.

¹ See e.g. the Book Performance Report for the online downloads of 2013 at www.or-as.be/blog/bpr2013.



Figure 1 - Structure and overview of the book (Source: Vanhoucke (2014))

2.1 Part 1. First comes the theory

2.1.1 Chapter 1. The data

The first chapter of the book contains fictitious project data and baseline schedules that will be used as points of reference for all calculations in later chapters. The three projects are based on empirical project data but are simplified and reduced in size (17 activities) to facilitate the calculations. For each project, the network data, the schedule data and the project progress are shown. For the sake of simplicity, the use of the fictitious project dataset is subject to assumptions and simplifications. More precisely, the construction of a baseline schedule is therefore kept fairly simple as it boils down to a straightforward critical path schedule. However, straightforward extensions to more general project data can be easily applied without losing generality and many of these more complex extensions can be found in the other book by Vanhoucke (2012b). Some of the simplifications and assumptions made are summarized along the following lines:

• Network data: The precedence relations

between activities are finish-to-start relations with a minimal time-lag of zero, and therefore, more generalized precedence relations are not taken into account.

- Baseline schedule: The baseline schedule is constructed using simple critical path calculations resulting in an earliest start schedule. No extensions to resource levelling techniques and extended scheduling features such as activity splitting and the presence of time constraints are used.
- Progress: The real activity costs are assumed to be linearly dependent on their real durations and hence a linear trade-of between the activity duration and cost is assumed.

2.1.2 Chapters 2 to 5. Project control using EVM/ES

All blocks displayed at the upper part of the figure are discussed in chapters 2 to 5 and make use of the well-known project control technique, known as Earned Value Management (EVM), extended with the more recently developed Earned Schedule (ES) method (Lipke, 2003). Chapter 2 gives an overview of the key metrics used in an EVM system and their use for calculating the time and cost performance of projects in progress. Chapter 3 extends the three key metrics with a fourth ES key metric, and shows its use to calculate an alternative time performance time metric. Unlike the performance no alternative measurement. for cost performance measurement is presented. In chapter 4, the ES metric will be used to calculate the adherence of the project baseline schedule, and a concept known as the p-factor approach (Lipke, 2004) is presented. Chapter 5 shows how the EVM and ES performance metrics can be used to forecast the final duration and cost of a project. The EVM performance metrics can be used to predict the expected duration and cost of a project in progress, while the ES performance measures can only be used to calculate an alternative prediction of the expected duration of the project. Due to the close relation and similarities between the EVM and ES methods, they are often referred to as the EVM/ES method. This EVM/ES method will be used in the so-called top-down

project control approach of chapter 7.

2.1.3 Chapter 6. Schedule risk

The bottom part of the figure is discussed in chapter 6. The so-called Schedule Risk Analysis (SRA) technique is used to measure and assess the impact of variation in activity time and cost estimates on the project objectives. Both time and cost sensitivity measures are discussed using either simple and straightforward three point estimates or more advanced statistical distributions such as the lognormal or generalized beta distribution. The research done for this chapter mainly comes from the study published in the flagship journal Omega International Journal of Management Science (Vanhoucke, 2010c). Similarly to the EVM/ES control techniques, the various SRA metrics and measures discussed in chapter 6 are used in the bottom-up project control approach of chapter 7.

2.1.4 Chapter 7. Schedule control

In chapter 7, all techniques and calculations presented in the previous chapters are brought together in two alternative project control methods that aim at measuring the performance of projects in progress and generating triggers for corrective actions to bring projects in trouble back on track or to timely exploit project opportunities. The two alternative control methods differ in the fact that their measurement points are taken at different levels of the Work Breakdown Structure (WBS), as summarized along the following lines:

- Bottom-up project control starts at the lowest levels of the WBS and relies on the sensitivity metric values of a schedule risk analysis to determine which of the project activities must be subject to intensive control.
- Top-down project control relies on the performance measures given by the EVM/ES systems that act as detectors of project problems at lower levels of the WBS.

In order to be able to efficiently control projects in progress, these two alternative control methods should be integrated, which is the main reason why the word *integrated* is used in the title of the book. It is shown that prior knowledge of your project data will give you more information on how to efficiently integrate all the topics of the book into an improved project control system. This chapter is inspired on the research study available in a second publication in the journal Omega International Journal of Management Science (Vanhoucke, 2011) for which a brief summary is given in an article (Vanhoucke, 2012a) published in the Measurable News.

2.2 Part 2. Then the practice

In this second part, the use of the EVM/ES and SRA methods is illustrated using two software tools. ProTrack is a commercial software tool that is freely available to students to get acquainted with the integrated project management and control theme using real project data or case studies. The P2 Engine tool is a more sophisticated version of ProTrack and is intended to be used by master students and PhD researchers and requires some basic scripting skills.

Through the use of three small illustrative example projects, the overview of all mathematical details (Part 1. First comes the theory) and the availability of two software tools (Part 2. Then the practice), the reader should be able to recalculate almost every little detail presented in the book. Where necessary or appropriate, references to other books or articles are given in order to stimulate further reading, but no effort has been made to give a complete literature overview. Moreover, almost each chapter is illustrated by a project report showing simply yet easy-to-understand dashboards to measure the performance of projects in progress.

3 Conclusions

This book is really the result of the interaction with many of my students. Therefore, I truly believe that the book discussed in this article is fundamentally different from my two previous books, and holds the middle between the methodological details of a research book and the general overview descriptions of a student handbook. Despite the huge amount of excellent articles

and other books available in literature, I believe the contribution of this book is threefold as briefly illustrated along the following lines:

- Technical scope: Rather than a research book with methodological details on EVM/ES and SRA systems or a detailed overview book on the three dimensions of dynamic scheduling, this book serves as a more technical book containing formulas mathematical details on the and calculations of the EVM/ES and SRA metrics. In a first part of this book (First comes the theory), all mathematical formulas are shown and illustrated on three fictitious project examples. The summary reports are given to illustrate the use of metrics and concepts for project performance reporting purposes.
- Ready for use: The EVM/ES and SRA concepts presented in this book should be used in a project management and control setting by students, professionals and researchers. In the second part of this book (*Then comes the practice*), both a commercial software tool ProTrack and a research tool P2 Engine are presented and an overview of their basic features is given. The integration of these tools with spreadsheets should allow the readers to quickly access all the underlying mathematical details leading to a better understanding.
- Illustrative examples: All metrics. mathematical calculations and underlying concepts are illustrated on three simple example projects. These illustrative projects are small in size and are fundamentally different in structure in order to illustrate the full potential of the use of EVM/ES and SRA methods. No references to case studies that show the potential of the concepts in a real business environment are given, and the reader is referred to many other excellent books available in literature.

Therefore, this book on *integrated project management and control* should be useful for anyone who wants to understand the theory first, and then wants to translate the theory into practice using software tools. It is written for students, professionals and academics with an interest and/or experience in running projects as well as for newcomers

in the area of project control with limited knowledge of the EVM/ES and SRA concepts.

4 Acknowledgements

The support by the concerted research action (CRA) funding received in 2012 at Ghent University (Belgium) for the project titled "Searching for static and dynamic project drivers to predict and control the impact of management/contingency reserve on a project's success" is acknowledged.

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6 The author



Prof Dr Mario Vanhoucke mario.vanhoucke@ugent.be

Mario Vanhoucke is Full Professor of Management and Operations Business at Ghent University (Belgium), Research Vlerick Business School (Belgium, Russia, China) and University College London (UK). He has a Master's degree in Commercial Engineering and a PhD in Operations Management from the University of Leuven (Belgium). At Ghent University, he is the program director of the Commercial Engineering program where he teaches Project Management and Applied Operations Research. At Vlerick Business School. he teaches Decision Making for Business and Business Statistics to Master and MBA students.

His main research interest lies in the integration of project scheduling, risk management and project control using combinatorial optimization models. He is an projects, has advisor for several PhD published more than 60 papers in international journals and is the author of three project management books published by Springer (see www.or-as.be/bookstore). He is speaker international regular on а conferences as an invited speaker or chairman. He is also a regular reviewer of articles submitted for publication in international academic journals.

Mario Vanhoucke is a founding member and director of the EVM Europe Association (www.evm-europe.eu). He is also a partner in the company OR-AS (www.or-as.be) which released a third version of its project management software tool ProTrack 3.0 (www.protrack.be). ProTrack is an advanced scheduling product which focuses on the integration of scheduling, risk, control management and online learning through a PM Knowledge Center (www. pmknowledge center.com). He leads a research group which has obtained Concerted Research Actions (CRA) funding of more than € 1 million for an integrated PM research study, that will be carried out in collaboration with Ghent University (Belgium), Vlerick Business School (Belgium), The European Organization for Nuclear Research (CERN, Switzerland), University College London (UK) and George Washington University (USA). To that purpose, a derivative of the software tool ProTrack, known as the PM programming tool P2 Engine (www.p2engine.com), has recently been developed that will be used for testing

novel ideas by the CRA research team members.

project management research The undertaken by Mario Vanhoucke has received awards including multiple the 2008 International Project Management Association (IPMA) Research Award for his research project "Measuring Time: А Proiect Performance Simulation Study" which was received at the IPMA world congress held in Rome, Italy. He also received the "Notable Contributions to Management Accounting Literature Award" awarded by the American Accounting Association at their 2010 conference in Denver, Colorado.