

# **The Art of Project Management**

A Story about Work and Passion

(Sixth Edition)



**Mario Vanhoucke**

# The Art of Project Management

## A Story about Work and Passion

Mario Vanhoucke

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# The Art of Project Management

## A Story about Work and Passion



**“To succeed you have to believe in something with such a passion that it becomes a reality.” - Dame Anita Roddick**

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# Introduction



# The Art of Project Management

## Make anything happen

**“Being a project manager is the most fascinating job in the world!” - Mario Vanhoucke**

This is how I start my teaching sessions on Project Management (PM). I use this quote to convince young people that Project Management is about **passion**. Passion for the research that we started back in 1996. Passion for narrowing the bridge between our research and the daily PM practice. Passion for the PM software tools that help us in making better decisions. Passion for meeting new people and hearing their view on PM. But also passion for the risk analyses, the Monte Carlo simulations, the underlying maths and models and the novel algorithms to improve current best known solutions. It's indeed the most fascinating job in the world.

It's out of that passion that we have created OR-AS (acronym for Operations Research - Applications and Solutions) in 2007. As a collaboration between an academic and an IT specialist, we have created a number of software tools and online products to share our passion with the world. At least, that was our mission from the very beginning: bringing practitioners as well as researchers together to share knowledge and exploit opportunities on PM. After so many years, we have therefore decided to bundle our most fascinating endeavors in a single book that you now have in front of you. We hope you share a similar PM passion with us.

PM is a very general discipline, covering a wide range of important themes, ranging from mathematical analyses of risk and the construction of schedules to topics such as human resource management and procurement. At OR-AS, we mainly look at the PM world from an Operations Research (OR) perspective. Although we realize that this might look like a rather narrow view on the PM discipline, we believe that the themes that we discuss are probably the main reasons why PM is fundamentally different to so many other disciplines.

The general mission of this book is to showcase that **"Research meets Practice"**: we aim at bringing practice closer to research and research closer to practice. It is our aim to present the relevance of the integration between baseline scheduling, risk analysis and effective project control and to stimulate and challenge both project managers and researchers to

go in discussion, aiming at bringing the current state-of-the-art knowledge to a higher level. That is why we believe that we have to share our knowledge, even if it comes from failures or less successful projects, learning from each other, criticizing each other and helping each other to do better, with only one goal in mind ... bringing Project Management to a higher level.

This book starts with a short introduction on the three central themes of dynamic scheduling, known as **Baseline Scheduling**, **Schedule Risk Analysis** and **Project Control**. Afterwards, you will find the following topics summarized in five parts:

- **Collaborations**: A presentation of the most interesting and inspiring (often still on-going) collaborations between our group and PM experts.
- **Products**: An introduction to our software tools and online products that might have relevance for many of you.
- **Books**: A summary of PM books and the story behind the writing of them.
- **Research**: An overview of our research endeavors to show that all the work is not done in an isolated world but is based on research experience from the professionals and needs from the real world.
- **Education**: Through our teaching sessions at universities and business schools, we reach our most critical but also our most promising group of people: the (young) students full of energy and ready to start a promising career in PM.

We hope that this book gives you a nice overview of our passionate work at OR-AS in collaboration with our team of researchers at Ghent University, Vlerick Business School and UCL School of Management (University College London) and the many practitioners spread all over the world.



Mario Vanhoucke



Are you

- A Project Management student?
- A PhD researcher?
- An OR-AS customer?
- An EVM Europe participant?
- A PM professional?

Then let this book change your perspective!

# A Story about Work and Passion

Sixth edition

## “Life begins at 40.” - Walter Pitkin

On March 14, 2013, I introduced the first edition of “The Art of Project Management: A Story about Work and Passion” on the OR-AS website. On that day, it was my 40<sup>th</sup> birthday, and I felt I needed something different than only academic writings and lecturers to

communicate with my audience. At the age of 40, you care less whether people will like or dislike what you do. I just did. Life begins at 40!

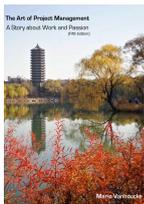
Today, the 6<sup>th</sup> edition of the book is now ready and available for free download. Enjoy!



### 6th Edition (April, 2021)

Update of existing articles but also new articles on:

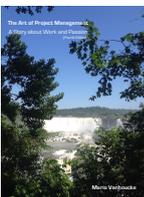
- New research on analytical project risk and control
- New summary article on research awards
- About e-learning and project data



### 5th Edition (January, 2019)

Update of existing articles but also new articles on:

- Bookstore added
- New collaborations and research projects
- From London to Beijing, and then to Xi'an



### 4th Edition (January, 2017)

Update of existing articles but also new articles on:

- Inspirational trips for writing books and case studies
- Education at UCL School of Management, MundoPM and Academy of Osteopathy
- New research and new software tools (in MS Excel)



### 3rd Edition (May, 2015)

Update of existing articles but also new articles on:

- Collaborations with José Coelho and INESC TEC and introduction of “PSG Extended”
- Teaching at Peking University, University College London and Vlerick Business School
- New article on the academic peer review process



### 2nd Edition (April, 2014)

Update of existing articles but also new articles on:

- Collaborations with Walt Lipke, EVM Europe and College of Performance Management
- Introduction of the ORASTalks app and the new bookstore
- Blended learning and teaching abroad



### 1st Edition (March, 2013)

Summary book on the work done at OR-AS and Ghent University:

- Overview chapters on OR-AS products and collaborations
- Summary chapters on PM research and teaching
- ... but also chapters about friendship, passion and future ideas

Want to learn how data can help you making better decisions for managing projects? The technical business novel "The data-driven project manager" might be the book you really need.

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## Project Management Will be increasingly data driven

Interview with Mario Vanhoucke by Journalist Yu Yanjuan (Spring) on 2019.01.21

This interview is published on [www.pmreview.com.cn](http://www.pmreview.com.cn)

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Mario Vanhoucke, PhD in Operations Management, is now and has been a professor in many universities worldwide such as Ghent University, Vlerick Business School, University College London, Northwestern Polytechnical University and Peking University in China.

In recognition of his contributions to PM, he has been recognized by many awards such as 2017 Elsie Cropper Award for Best Paper, 2008 IPMA Research Award, PMI Belgium PhD Award, just to mention a few. He is also a productive author with numerous books and papers published worldwide. His recently published book is **The data-driven project manager: A statistical battle against project obstacles**, which is well-received internationally.

### INTERVIEW

#### Part 1: Data-driven Project Management

**Q1: Your latest book is "The Data-driven Project Manager". What is it mainly about? What's the biggest selling point of this book?**

Mario Vanhoucke: The book gives a full overview of data-driven project management, going from planning to risk analysis and resource management, and ultimately, to project monitoring and control. It focuses on the use of data and the integration of methodologies to support better decisions to bring projects back on the right track.

The book does not only give a summary of tools, techniques and methodologies, but instead it takes a look behind the techniques to show why these methodologies work for some projects, and why they might fail for other projects. In my opinion, getting insights into these data-driven tools is crucial to a better understanding, and a better translation

of these tools to a practical setting. And of course, the book is not a dry summary of tools and techniques, but it is written as a technical story, from a project manager's point of view. Emily Reed, the protagonist, is in charge of a new project, and wants to convince her team that using data for understanding the project is the only way to go forward. It could be the story of your company!

**Q2: What role will data play in managing projects in the future?**

Mario Vanhoucke: It is of course tempting to say that data will be key in the future of managing projects when artificial intelligence and machine learning algorithms will take over the role of the project manager. Although I believe it won't go that fast, there is nevertheless a spark of truth in it. I believe that data will play a crucial role in managing projects for the following reasons:

## Project Management Will be increasingly data driven

1) All methodologies for planning projects, analyzing risk and controlling projects require data, so a good understanding about the importance of project data is key to decision-making when managing projects.

2) Since data is key to making decisions, ultimately, people are involved in the decision-making process. People have their own ideas about the project, and with their experience (and their biases), they make decisions to bring the project back on track. It is well-known that these biases lead to sometimes irrational and wrong decisions. Data can be a very good alternative approach to overcome the biases of people.

3) Data will become more and more important to detect project problems. We have done tests with data-driven tools to find out when the project manager should react and take decisions to bring projects back on track, and found that these tools can sometimes better predict (compared to humans) when problems will have a bad impact on the project outcome. Data-driven tools will more and more replace parts of the decision-making process, and get things done without the intervention of people.

**Q3: You once made a presentation titled “The big data project manager: Harder, better, faster, stronger”. Is it about qualities of project managers in the era of big data? Would you like to elaborate on that?**

Mario Vanhoucke: With this presentation, I wanted to warn people that with the rise of data-driven decision-making, managers have to be sure that they jump on the wagon now before it's too late. It's tempting to say that these advanced methodologies are too complex, too mathematical and too quantitative, but it's wiser to say that a good understanding of these data-driven methodologies is key to the success of the business, and therefore, a good understanding is crucial. I just want to say to my students that it's now the time to learn more about these

techniques, because they will become more important than ever. Jump now and learn about them before things get harder, better, faster, stronger.

**Q4: With the rise of gig economy, what challenges will project management face and how can we overcome them?**

Mario Vanhoucke: I'm not an expert in this matter, but the sharing and free economy has started to become more and more important due to the rise of the internet and the free availability of goods and services. Data will be key in this process, since the whole internet explosion has been one (and will continue to be one) of data, algorithms, and artificial intelligence and machine learning algorithms. I read a lot about the rise of the gig economy, its benefits, and its risks, and despite the different opinions I have read in the field, one thing is sure: DATA ARE HERE TO STAY!

**Q5: As you have said, people are important in projects but people tend to be biased. What should we do to deal with this barrier?**

Mario Vanhoucke: Let the data speak! As said before, the good thing about data is that they don't lie. Data allows quantification, data has no feelings, and it enables the project manager to compare alternative proposals without taking people's biased opinions into account. Of course, data is not there to replace people, but rather to help people overcome their biases. That's why the main message of data-driven project management is: “First the data, then the gut-feeling”.

**Part 2: Integration Is a Trend in PM**

**Q6: You said that project management had evolved as a special discipline to a more integrated decision-making process approach. “Integration” is a trend in project management, right?**

Mario Vanhoucke: I am totally convinced about that! Planning without risk is nonsense. Control without planning is worthless. Risk analysis without a plan is impossible. One of the

**“one thing is sure: DATA ARE HERE TO STAY!”**

most important lessons to learn in my book is that the key to a better PM is “integration, integration, integration”. In my academic articles, I have shown that integrating planning, risk and control leads to improved efficiency for managing projects. That's the main message of the book. And above all, this is not just a bunch of words: the main learning message is tested in several academic studies!

**Part 3: Trust and Control Should Go Hand in Hand**

**Q7: You believe that the old saying “trust is good, control is better” will be more important than ever. Why?**

Mario Vanhoucke: Because trust is something that you cannot quantify. Trust is good, and it is a requirement when we are working in a team. But it is not a good indicator for validating the quality of decisions. Control is better. Control does not override trust, but instead, works like its partner: trust and control should go hand in hand. Control quantifies the impact of decisions, and benchmarks different alternative proposals on an objective basis. Trust is gut-feeling, emotional and non-quantifiable. It is nice and crucial to have trust, but it should not be the main objective when managing projects.

## Project Management Will be increasingly data driven

**Q8: In VUCA era, what leadership skills are essential for project managers?** (VUCA = volatility, uncertainty, complexity and ambiguity)

Mario Vanhoucke: Without any doubt: Understanding risk. It's key to business. Understanding risk is not the same as being able to predict what will go wrong, since no one can predict the future. Instead, it means that a project manager should have insights into the possible impact of different sources of risk. Understanding the impact of risk enables the project manager to better focus on the most sensitive parts of the projects (i.e. the ones with the biggest possible impact if the risk occurs), and a better focus means a more efficient decision-making process.

### Part 4: Planning Is Much More than Just Planning

**Q9: Based on your research, what are the top reasons for project failure?**

Mario Vanhoucke: Bad preparation! I'm not talking about a simple Gantt chart but about a clear understanding of the relations between project activities, the impact of possible events that go wrong, the allocation of resources with good understanding about the impact of risk and the knowledge that control only works in collaboration with a plan and risk understanding. Consequently, planning is much more than just planning. It's understanding your project and be prepared for the unexpected.

### Part 5: Teaching PM Is like a Performance

**Q10: Looking back at all these years in PM teaching, what are your feelings and reflections?**

Mario Vanhoucke: My feeling is that everybody has a different opinion about project management. 15 years ago, it was not done to talk about planning tools and risk analyses. It was all about leadership, people skills and that stuff. Now today, it is good to talk about data,

and suddenly, the quantitative methodologies are important again. Honestly, I think teaching is bringing a message and convince students that it all makes sense. If there is one thing I like about teaching, then I should say that it is the way you teach the content, which is more important than the content itself. I talk about planning, control and risk, probably the most boring theories invented on earth, but I tell my students what they mean to them, how people can use them, how they work, and how they fail. I love teaching: it's like a performance.

**Q11: Every course teaching can be called a project. Do you think you have managed them successfully?**

Mario Vanhoucke: Haha, that's a good question. I'm not sure that I practice what I preach. I try hard, sometimes with success, while other times I fail. Maybe that's why it is indeed a project. If I fail, I correct, as a good project manager does.

**Q12: You've been lecturing in several universities in China. What's your impression on China, Chinese students and project management in China? Will Project Management enjoy a promising future in China?**

Mario Vanhoucke: I indeed lecture a lot in China, and I love my Chinese students. They are willing to learn, are not afraid of data, mathematics and other complex tools, and are eager to improve the business. I am convinced that Project Management will become more and more data-driven, not only in China, but in the world. But maybe the Chinese students can take a front role in this process. In my opinion, a rising economy combined with a large pool of young ambitious managers (my students) is the ideal recipe for a more data-driven business future. I will keep coming back to China and keep teaching these young potentials about the relevance of data-driven management for business.



Want to learn how to ensure project management is aligned with your organisation's strategic goals? Our programme on **project management** might be just the one for you. For more information, get in touch with [mario.vanhoucke@vlerick.com](mailto:mario.vanhoucke@vlerick.com)



## Data-Driven Project Management IN A CLEAR LANGUAGE

Interview with **Mario Vanhoucke**

This interview is published on [www.vlerick.com](http://www.vlerick.com)

[Homepage](#) > [Research & Faculty](#) > [Our Expertise](#) > [Operations & Supply Chain Management](#) > [Data-driven project management in clear language](#)

Having published eight academic books, Professor Mario Vanhoucke knows what he is doing with *The Data-Driven Project Manager*. The only difference is that, this time, his new book is written in the form of a novel.

### Meet Emily Reed

Resourceful, problem-solving, with a real affinity for figures, that's Emily Reed for you. As a young project manager, she is responsible for the construction of a new tennis stadium at GlobalConstruct. She is also completely convinced that data should form the basis for all decisions. That's handy, because Jacob Mitchell, CEO, wants to introduce a new project-management method and encourages Emily and her colleagues to immerse themselves in the data, looking for better ways to arm the organisation and the project against unexpected obstacles. In professional literature, data-driven project management is also

known as integrated project management and monitoring, or dynamic planning. That's what this book is about. All the quantitative aspects of project management are covered in detail: time management, cost control, scope management, planning, risk analysis, project follow-up and earned value management, but told through the story of an organisation that is making the switch from traditional to data-based project management.

### Lifelike

Storytelling may be trendy in marketing circles these days, but Mario has been convinced for a long time that it works: "After 20 years of academic research, consultancy and teaching all around the world, I have learnt that everyone has their own way of understanding things. A joke that will have the audience in stitches in China may not necessarily work as well in

Belgium. An explanation that convinces one group may miss the mark with another. My story brings these years of experience together and is therefore the greatest common denominator for what works. That's also why I wasn't able to write it until now."

All the dialogues are taken from real life, just like the characters: the technician who only looks at the figures and data, and goes so fast that no one can keep up with him, the opponent who is absolutely not interested in a data-driven approach, the colleague who does want to understand it all but is struggling so far and so on. "For each character I could name ten people that I have met over the years. All their different perspectives are covered in the story. That was a conscious choice. I can say how best to approach something, but there will always be those who look at it differently and who have their reasons for doing things another way."

## Data-Driven Project Management

### In a clear language

#### Gut instinct up for discussion

Mario doesn't want to suggest that the use of data is the be all and end all. "Data analysis can help to solve problems but, most importantly, it puts our gut instinct up for discussion. Cognitive psychology has shown us that our intuition is usually wrong. Think of Daniel Kahneman's masterpiece: Thinking fast and slow. Risk analysis is an important aspect of project management - a reason why it is better not to be led by your intuition. So an important lesson from the book is: first the data, then the feeling. You can still decide to ignore the results of the data analysis, but this should be done consciously and, if you have a good reason for your choice, I don't have a problem with it. In that sense, this book is aimed primarily at doubters and at project managers who want to combine the two: data analysis and management on the basis of a gut instinct."

#### Something for everyone

"For anyone who is already convinced that it's best to base risk analysis and project management on data, as I am, the book will mainly act as a reference for various project-management and analysis techniques, or an interesting novel," Mario smiles. That being said, the reader will find an extensive overview of all the academic sources the book is based on in the last chapter. "Sometimes things are simplified in the story, for clarity, and academics will notice that - I admit that too. But if you are interested in the details, you will find links to all the relevant papers there. So even those who are already sold can learn something new. This time, it was my intention to make complex technical processes accessible to a wider audience. So far, my research has mainly reached my own circle of academic insiders."

#### Big data? Good data!

"You know," he says, "these days everyone is talking about big data, but it's not always clear exactly what they

## DATA-DRIVEN PROJECT MANAGEMENT

### An elective course module

Data Driven Project Management is a highly interactive and practical course module focusing on the integration of planning, risk and control. The training enables students to get acquainted with the quantitative project management concepts using an integrative four-phased case study. The training is based on practical experience as the case study aims at delivering the required technical skills to manage large and complex projects, but also tests the students' performance under time pressure, their critical mindset, as well as communication skills and quality of written analyses.

[www.vlerick.com](http://www.vlerick.com)

Homepage > Programmes > Masters Programmes > Masters in General Management

mean by that. "Tell us what we should be doing will all this data," they ask me. I explain that in this book. I say that it's not so much about data as such, but about what you do with it. Data should support decisions. Algorithms don't take decisions, people do that. By using data well, you can not only see whether you are right or wrong but, most importantly, where there is room for improvement."

#### Further reading

The Data-Driven Project Manager, A Statistical Battle Against Project Obstacles is published by Apress. You can also order the book on Amazon.

Discover also the complete overview of all the author's books about project management and decision making in the bookstore part of this book.

**"For each character I could name ten people that I have met over the years. All their different perspectives are covered in the story."**



Want to learn how to ensure project management is aligned with your organisation's strategic goals? Our programme on **project management** might be just the one for you. For more information, get in touch with [mario.vanhoucke@vlerick.com](mailto:mario.vanhoucke@vlerick.com)



## Project Management WHY TAKE IT SERIOUSLY?

Interview with Mario Vanhoucke and Antonio Nieto-Rodriguez

This interview is published on [www.vlerick.com](http://www.vlerick.com)

Homepage > About Vlerick > News > Project management – why take it seriously?

Project management awareness and good project managers are critical to the success of today's organizations. But this where too many fall short. Mario Vanhoucke is professor at Vlerick Business School, University College London and Ghent University. His research focuses on project management using earned value management. Antonio Nieto-Rodriguez is director of the program management office at GlaxoSmithKline. He is a lecturer in project management at Vlerick as well as professor and visiting professor at Duke CE and Instituto de Empresa. They draw on their complementary backgrounds to explain why project management is important and why organizations should invest in the development of project management skills and capabilities.

### Projects are everywhere

“Project management is a set of tools and techniques used by organizations to create value, to implement changes and to solve problems,” says Antonio. “It’s a profession. But it’s also a core skill in our lives. We deal with projects from an early age onwards – learning to ride a bike, going to university, building a house, planning our wedding etc. The same holds for organizations: any change they want to implement, new products or services they want to launch, markets they want to enter ... these are all projects and they must be managed.”

Mario nods in agreement. “Project management is a broad concept indeed. It encompasses managerial aspects such as leadership, motivation and stakeholder management as well as quantitative aspects such as planning, risk analysis, monitoring and control. And while the managerial aspects are no less important, the quantitative

aspects are precisely what sets it apart from general management.”

### More important than ever

“Organizations need to constantly evolve and innovate. Without projects, they wouldn’t be able to survive,” Antonio says adamantly. “So, they need to invest in project management skills and capabilities.”

Mario explains why this is more important than ever: “Things are becoming increasingly short-lived. Projects, by definition, have a finite life span, with a beginning and an end, and this life span gets ever shorter. Careers shorten as well – people seem to prefer to work on a project basis as it were. Today’s dynamic environment, where anything can change from one day to the next, calls for a project-based approach. Projects used to be the realm of IT and engineering, but not anymore.”

## Project Management Why take it seriously?

### Experience, training and best practices

What makes someone a good project manager? Antonio: “First of all you need experience and maturity. It’s difficult to take on the role of project manager if you’re fresh from college. The job requires lots of communication, convincing, and networking. You can’t sell a project to C-level executives unless you’re confident and understand how it ties in with your organization’s business and strategy. Second, you need proper training. Project management isn’t something you learn in high school and only few masters programmes teach it. And third, you should follow best practices, which are similar in any industry, i.e. build a business case, develop a plan, align the stakeholders etc., and execute the project in a disciplined, step-wise fashion.”

### Intuition or big data?

Mario picks up on Antonio’s last point. “So you need to know how to develop a good plan and understand its purpose. That’s one of the reasons why in our programmes we don’t focus on a specific methodology, such as Prince2, PMBOK or Agile. More important than the method are the fundamental principles behind it and understanding why they are important. When should you intervene? Most people will answer ‘when something goes wrong’. But a three-week delay at some stage can be perfectly acceptable if it doesn’t jeopardize the final deadline or budget. It’s also important to realize that project management – monitoring, risk analysis etc. – is not about intuition or gut feeling. It’s about statistics, about measuring performance and analyzing the impact of deviations. It’s about knowing when a deviation is a problem.” He pauses, then adds: “Mind you, the developments in big data and analytics have had a hugely positive impact on the quantitative aspects of project management. If you want to use a decision support system to monitor your project, you need

statistical data. Until five years ago precious few organizations had access to such information. That much has changed.”

### Pitfalls to avoid

What are the typical challenges project managers face? “There are plenty, but let me name three,” says Antonio. “First, stay focused. Organizations should set clear priorities to avoid a proliferation of projects, while as a project manager you shouldn’t have to try to juggle too many different projects at the same time. It’s also important that you speak the same language as your stakeholders. Marketing directors aren’t interested in the details of the plan to set up a new CRM system, they want to know how it will benefit the business. And finally, some project managers are good at managing the plan, but they fail to keep their sponsors on track. Project management is as much about managing the project as it’s about managing your boss.”

Mario smiles: “And, at the risk of repeating myself, another challenge is to balance the managerial and quantitative aspects. The analytics provide you with a sound basis to help you convince your stakeholders. I work with project managers at CERN in Switzerland. They’re great people managers, but they also manage

## PROJECT MANAGEMENT

### In line with your strategy

Project-based working radically differs from other work methods. Just like its opposites of routine work and improvising, project management has its characteristics and challenges of its own. These days, project management is no longer solely considered as a set of static planning techniques. Focus is shifting toward other aspects such as dynamic planning and control, coaching and directing project teams and optimal structuring of projects. This programme offers a clear focus on the business practice and guarantees a positive impact on your projects.

This 4-day programme focuses on the essentials of proper project management practices: project and portfolio management, planning, scheduling and team management.

[www.vlerick.com](http://www.vlerick.com)

Homepage > Programmes > Management Programmes > General Management > Project Management

their multimillion dollar research projects in an extremely quantitative, analytical way. What they do is a textbook example of integrated project management and control.”

### Shared responsibility

“Project management isn’t a task for project managers alone, the entire organization needs to be project-minded,” Antonio points out. “This means project sponsors and senior management would benefit from training as well. Project sponsor isn’t just a name on a project initiation document. Sponsors and senior management need to dedicate sufficient time. In a recent study by Forbes half of the participants stated that strategic projects fail due to a lack of buy-in and understanding from key stakeholders.”



# Dynamic Scheduling

What is...?

# Dynamic Scheduling

Integrating baseline scheduling, schedule risk analysis and project control



## But ... what is baseline scheduling?

“A goal without a plan is just a wish” (Antoine de Saint-Exupéry)

### Dynamic Scheduling

**Dynamic Scheduling** is a Project Management methodology to plan, monitor and control projects in progress in order to deliver them on time and within budget to your client. Its main focus lies in the integration of three crucial aspects, as follows:

- **Baseline Scheduling:** Plan your project activities to create a project timetable with time and budget restrictions
- **Schedule Risk Analysis:** Analyze the risk of your schedule and its impact on your time and budget
- **Project Control:** Measure and analyze your project performance data and take actions to bring your project on track

In this “**What is baseline scheduling?**” brochure, the various inputs and outputs of baseline scheduling are highlighted. The two other aspects are summarized in the “**What is schedule risk analysis?**” and “**What is project control?**” folders.

### What is baseline scheduling?

**Baseline scheduling** is the act of determining start and finish times of each project activity within the activity network and resource constraints and results in an expected timing of the work to be done as well as an expected impact on the project’s time and budget implications.

#### Inputs

**Activities.** A list of tasks defined at the lowest level of the work breakdown structure (WBS)

**Relations.** Links between activities that determine when activities can start or finish (FS, SS, FF, SF)

**Estimates.** Estimates of activity durations and costs

**Resources.** Estimates of resource requirements with corresponding costs (optional)

#### Outputs

**Gantt chart.** A timetable with start and finish times for each activity

**Time and cost forecasts.** A total expected duration (Planned Duration (PD)) and budget (Budget At Completion (BAC))

**Management reserves.** A margin or buffer on the total time and cost predictions

### Why

Constructing a baseline schedule is a crucial step in the dynamic scheduling PM methodology since your project schedule will act as a **point-of-reference** for your schedule risk and project control steps.

### How

Baseline scheduling can be easily done on a computer using the **critical path** scheduling techniques as well as the **resource leveling** extensions of the stand-alone tool ProTrack ([www.protrack.be](http://www.protrack.be)). For a more integrated baseline scheduling approach, OR-AS relies on the P2 Engine ([www.p2engine.com](http://www.p2engine.com)) tools to fully integrate the tools in current or newly developed business systems.

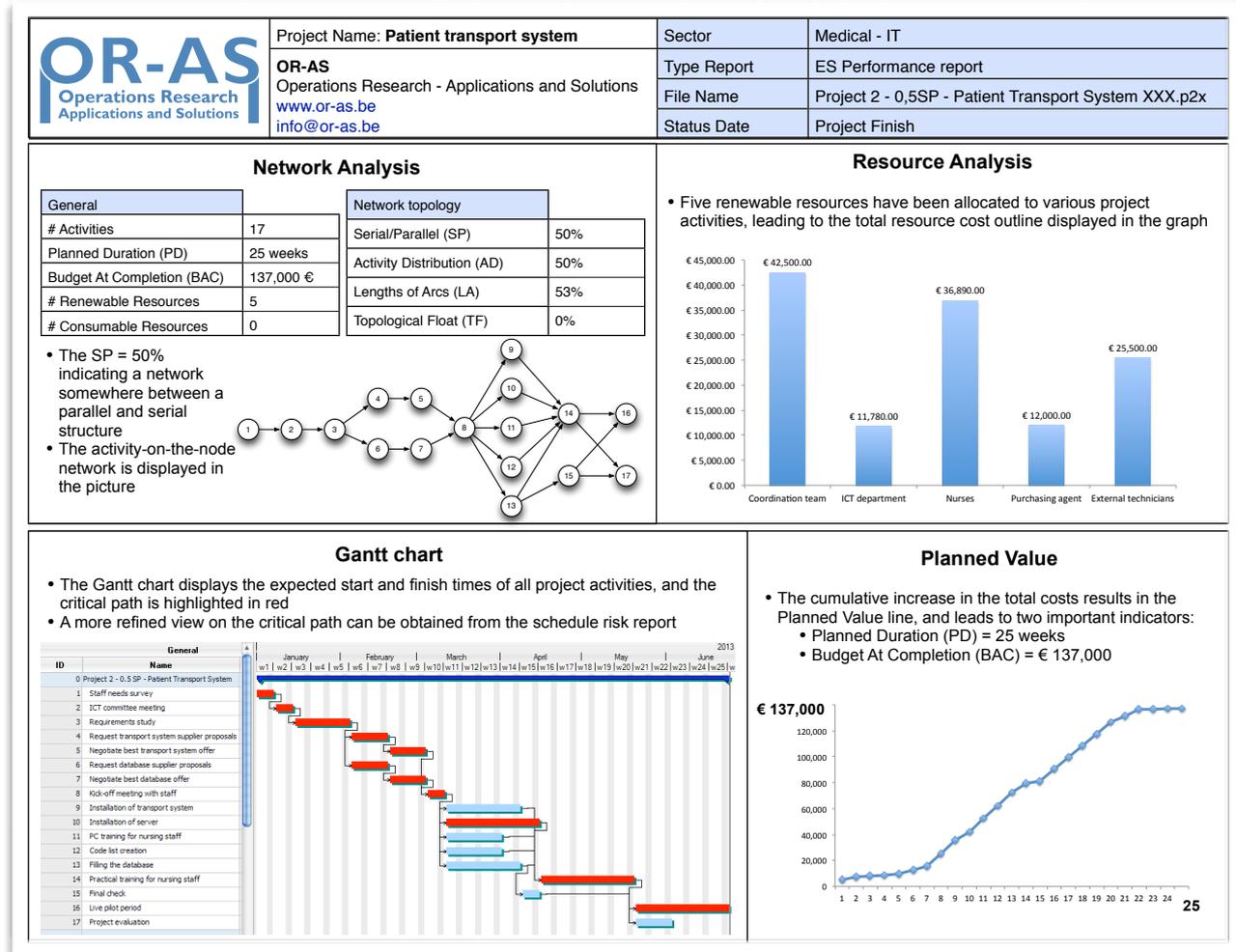
# Schedule Report

## Reports

The project baseline schedule information is summarized in an example baseline scheduling report and contains the following relevant information that can be used to monitor and control your project:

- Network analysis: The project characteristics of a project network are measured by the network topology indicators (SP, AD, LA, TF, see report) that describe the degree and amount of relations between activities
- Resource analysis: A detailed analysis of the resource use and its corresponding cost outline for the project
- Gantt chart timetable: An indication of expected start and finish times for each project activity
- Planned Value: The planned value is a cumulate increase of the project costs and will act as the point-of-reference during project control

<An example baseline scheduling report for a patient transport IT system project [Source: [www.or-as.be](http://www.or-as.be)]>



## Did you know that...

... the network topology metrics (SP, AD, LA, TF, see report) contain crucial information to determine where your focus must be during project control. They are crucial for the quality of a bottom-up risk approach and/or top-down control approach [Omega - International Journal of Management Science, 2011, 39, 416-426].

# Dynamic Scheduling

Integrating baseline scheduling, schedule risk analysis and project control



## But ... what is schedule risk analysis?

“Risk comes from not knowing what you're doing” (Warren Buffett)

### Dynamic Scheduling

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- **Project Control:** Measure and analyze your project performance data and take actions to bring your project on track

In this “**What is schedule risk analysis?**” brochure, the various inputs and outputs of baseline scheduling are highlighted. The two other aspects are summarized in the “**What is baseline scheduling?**” and “**What is project control?**” folders.

### What is schedule risk analysis?

**Schedule Risk Analysis** is a Project Management methodology to assess the risk of the baseline schedule and to forecast the impact to time and budget deviations on the project objectives.

#### Inputs

**Risk profiles.** Distributions of the duration estimates for activities (normal, skewed or any other distribution) to define a margin of error on the initial baseline estimates

**Simulation settings.** Fictitious project progress is simulated using Monte-Carlo simulations to analyze the sensitivity of the estimates and the impact on the project objectives

#### Outputs

**Sensitivity chart.** The sensitivity of activity durations, activity costs and resource costs is reported using sensitivity metrics and the impact on the project objectives is predicted

**Accuracy charts.** The accuracy of these predictions is reported and allows you to validate the quality of the risk analyses for your specific project settings

**Action thresholds.** The sensitivity metrics should be cleverly used to set actions thresholds and to support better management actions

### Why

The importance of analyzing the risk of your baseline schedule comes from the need of any project manager to restrict his/her attention to the most influential activities of the project that might have the biggest **impact** on your initial time and cost constraints. It enables them to take better management **focus** and it supports a more accurate **response** during project progress that positively contributes to the overall project performance.

### How

Schedule Risk Analysis can be easily done on a computer using the standard **Monte-Carlo simulation** runs or the advanced **risk distribution drawer** of the stand-alone tool ProTrack ([www.protrack.be](http://www.protrack.be)). For a more integrated baseline scheduling approach, OR-AS relies on the P2 Engine ([www.p2engine.com](http://www.p2engine.com)) tools to fully integrate the tools in current or newly developed business systems.

# Risk Report

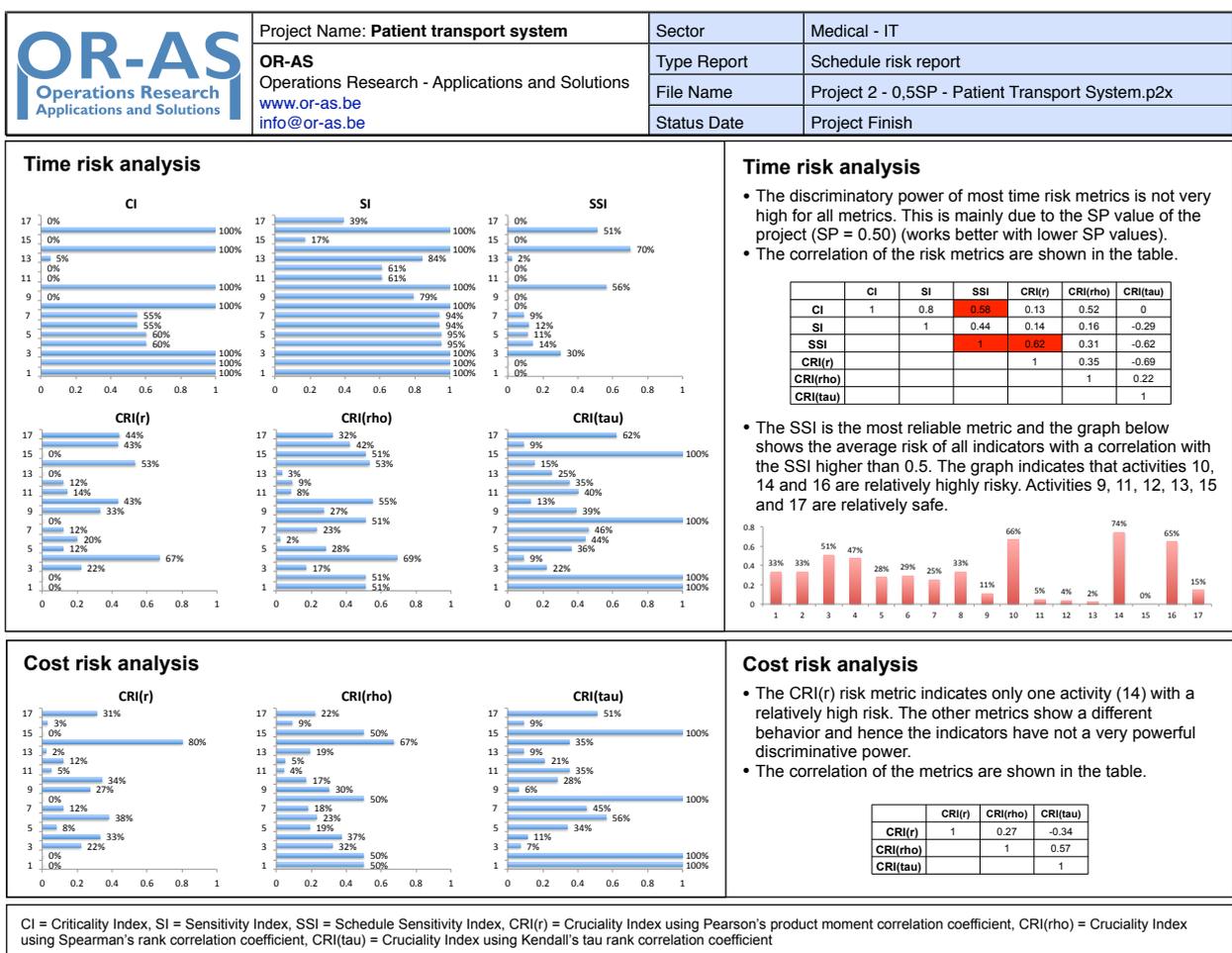


## Reports

The schedule risk information is summarized in an example schedule risk report and contains relevant information that can be used to assess the quality of the risk predictions and to monitor and control your project, as follows:

- Time risk analysis: Expected impact of activity duration changes on the total project duration
- Cost risk analysis: Expected impact of activity cost changes on the total project cost
- Resource risk analysis: Expected impact of resource use disruptions on the total project cost

<An example schedule risk report for a patient transport IT system project [Source: [www.or-as.be](http://www.or-as.be)]>



## Did you know that...

... it is known that the Schedule Sensitivity Index (SSI), originally proposed by PMBOK, is the best indicator for action thresholds for project control [Omega - International Journal of Management Science, 2010, 38, 359-370].

# Dynamic Scheduling

Integrating baseline scheduling, schedule risk analysis and project control



## But ... what is project control?

“If everything seems under control, you’re not going fast enough” (Mario Andretti)

### Dynamic Scheduling

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- **Project Control:** Measure and analyze your project performance data and take actions to bring your project on track

In this “**What is project control?**” brochure, the various inputs and outputs of baseline scheduling are highlighted. The two other aspects are summarized in the “**What is baseline scheduling?**” and “**What is schedule risk analysis?**” folders.

### What is project control?

**Project control** is the act of monitoring deviations from the expected project progress and controlling its performance in order to facilitate the decision making process in case corrective actions are needed to bring projects back on track. Both traditional Earned Value Management (EVM) and the novel Earned Schedule (ES) methods are used.

#### Inputs

**Activity progress.** A periodic estimate of the physical progress of each activity, possibly by use of activity micro deliverables

**Key metrics.** The physical progress estimates result in a comparison of the three key metrics, known as Actual Costs, Planned Value and Earned Value

#### Outputs

**Performance metrics.** A project performance analysis using performance metrics such as the SPI and SPI(t) for time, CPI for cost and the p-factor for the baseline schedule adherence

**Forecasts.** Predictions about the final project duration (EAC(t)) and cost (EAC) given the current performance today

**Accuracy.** An evaluation of the accuracy of the forecasts to validate the quality of the project control indicators

### Why

Efficient and effective project control is key to the success of a project since it provides **early warnings** to timely detect project **problems** or to exploit project **opportunities**, and it facilitates decisions for corrective actions to bring projects back on the expected performance.

### How

Project control can be easily done on a computer using the traditional **earned value management calculators** or its novel extensions to **earned schedule** and **schedule adherence** analyses of the stand-alone tool ProTrack ([www.protrack.be](http://www.protrack.be)). For more integrated tools, where the PM approach must be integrated in current or newly developed business systems, OR-AS relies on the P2 Engine ([www.p2engine.com](http://www.p2engine.com)) tools.

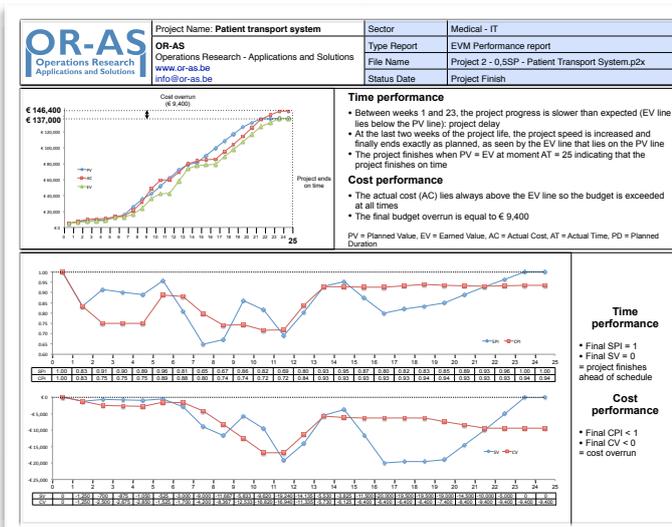
# Control Report



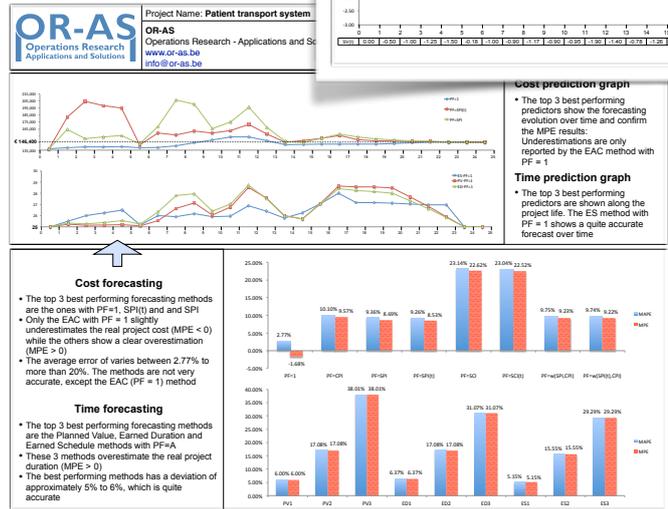
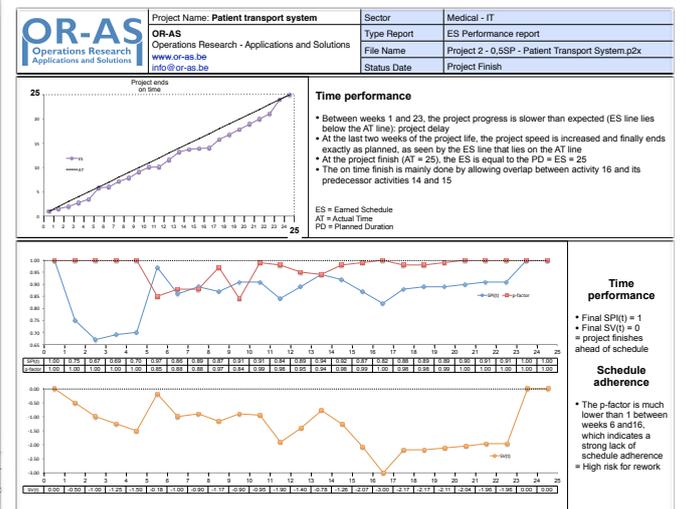
## Reports

Project control is the heart of project management and should be integrated with the baseline scheduling and schedule risk analysis phases. In doing so, all the relevant information can be periodically captured in three project control reports, as follows:

- EVM performance report: Periodic time and cost schedule variances and performance indicators
- ES performance report: Time indicators using a novel technique to measure the time performance of projects in progress
- Forecasting report: Forecasts about future expected time and cost project performance given the current EVM and ES performance reports



<Three example control reports for a patient transport IT system project (Source: www.or-as.be)>



## Did you know that...

... the Earned Schedule performance indicators (SV(t) and SPI(t)) outperform the Earned Value performance indicators (SV and SPI) to predict the final duration of a project (Journal of the Operational Research Society, 2007, 58, 1361-1374).

... top-down and bottom-up project control are two alternative control methods that can be used to increase the quality and effectiveness of performance indicators ("Measuring Time - Improving Project Performance using Earned Value Management", Springer, 2010).

# Collaborations



# A Journey to Answers

**“The important thing is not to stop questioning. Curiosity has its own reason for existing.” - Albert Einstein**

## Alone on a research island

Back in 1996, when I started my PhD, I was passionate about algorithms and programming languages. I preferred to have a job to work on my own, all alone, isolated from the real world, just me and my promotor, my computer, an occasional academic conference abroad and - most important - the unsolvable research questions I wanted to solve.

The years after 1996 were good years, and have led to a successful PhD in 2001. Not without difficult periods and many failures. Research has a very forward looking attitude and success comes from trying and failing and subsequently, from understanding the failure. But I think, looking back on it, that it was the best period of my (professional) life! I learned a lot at an amazing speed, and I had the time to test my new learnings to see whether they were relevant. The only thing I did was asking questions to myself, and then trying to find answers, or more questions.

On the presentation of my defense in 2001, a jury member asked me **why my research should be relevant in practice**, and I gave an answer which I can't remember. But deep inside of me, I wanted to say "never thought of it". But nevertheless, it was an interesting question! A new question to answer for the next years to come.

## Just the three of us

My initial search to answers on the relevance of my research began with a collaboration with two people who have probably defined the path of my career, and can now be considered as my two best and closest partners in my professional life.

The collaboration with **Stephan Vandevoorde** from Fabricom initially started from a shared interest to combine research results with practical relevance. Our joint efforts have brought us to conferences and workshops across the world where we have shown how two people with a different background, one researcher and one practitioner, work together to lift up the project management discipline.

The many presentations had one disadvantage: we talked a lot about project management, but we had little to show except our presentation slides. We needed software tools with nice graphical user interfaces to translate the content of our presentations into practical tools. The need for IT tools as an interface between the research and the outside world and the desire to bring research into practice has led to an intense collaboration with **Tom Van Acker**. After years of experimenting and small projects, our collaboration has led to the founding of OR-AS and the beautiful products that we have created throughout the years.

With the three of us, we have met many colleagues from the field. Some people came and went. Others stayed a little bit longer.

## Extending the collaborations

Throughout the years, we have met a lot of interesting people, giving us a lot of possibilities to join our forces. The collaborations with **Walt Lipke** (US) and **Kym Henderson** (Australia) who we initially have met in London have inspired us to jump on the Earned Value Management/Earned Schedule (EVM/ES) debate that was going on to better control the timing of projects in progress.

After the publication of my book **“Measuring Time”** and the collaborations with PMI Belgium, we have met many other people during our journey. Many people crossed our path, some collaborations were successful, other simply failed. It took us some time to realize that the three of us were not the only ones who tried to add some value to the project management discipline. There was a common interest in the PM topics, and the more we worked together with others,

the more we felt that sharing ideas could lead to improvements beneficial for both researchers and practitioners.

Some of the intensive collaborations that inspired us and our work at OR-AS are summarized along the next pages.

### Formalizing partnership - EVM Europe

In 2009, somewhere in London on a dark rainy evening, it was Kym's idea to join forces in a more formalized way. The common wish to share the experience and ideas of a few people who intensively collaborated with a broader audience has led to the creation of a new organization. EVM Europe has been founded in 2009 and has the mission to bring practitioners as well as researchers together to share their knowledge and exploit opportunities. At a yearly conference, EVM Europe showcases integrated project control best practices and novel research activities to Europe.

### Time flies

Ever since the formalized partnership with EVM Europe, the research activities have expanded with and without the EVM Europe members. Close collaborations with Pierre Bonnal for PhD research is an example of a nice collaboration within EVM Europe. But other endeavors, such as research stays at Lisbon, teaching activities in Brazil (for MundoPM) and many others have happened in the last years (see other articles in this book). These extended research activities have resulted in more books (cf. "Bookstore: Written communication with a targeted audience") and numerous research papers (cf. "References: Distributing academic research and scholarship"), and much more is on its way.

### What's next?

Bringing researchers and professionals together, sharing ideas and creating tools to make Project Management decisions have been our way to partially answer the 2001 question whether the research is relevant in practice.

But ... **"does it all lead to better research and more successful projects?"** That's the (new) question! We hope it does. The answer, up to now, is unknown, and the new question will probably never be answered completely. But the most important thing is not to stop questioning. And after all, it's just a story about work and passion that hasn't ended yet ...

# With Tom Van Acker

## OR-AS: The desire to bring research into practice

**“Real software should have a strong ability to transform a lot of data in easy-to-understand graphs and tables that facilitate decision making.” - Tom Van Acker**

Back in 2004, at the Gorges du Verdon in Alpes-de-Haute-Provence (France), two friends were talking about the joy in their lives and the passion in their work. Mario was telling about his work with Stephan Vandevoorde [see article “With Stephan Vandevoorde”] and the Operations Research methodology he used as a strong and quantitative modeling technique to find improvement for complex problems. He talked about the never-ending search to better translate research results into practical guidelines and rules-of-thumb relevant in practice.

**Mario:** “Despite the nice simulation projects we carried out with companies, it remained hard to show what we actually do for these companies. Since we didn’t use a real software tool or computerized graphical program, we could only rely on our algorithms and MS Excel files to actually show results of our simulations. But we needed our own tool to help managers to put our ideas into practice.”

Tom talked about his IT work and his view on IT tools as standalone software tools (applications) as well as services (solutions) to help people making better decisions. He explained that he wanted to create software tools that act as supportive tools, with a nice graphical user interface but also with a strong algorithmic engine running in the background.

**Tom:** “Real software should have a strong ability to transform a lot of data in easy-to-understand graphs and tables that facilitate decision making. Most software tools have nice GUIs, but lack a strong underlying methodology.”

It seemed like both friends talked about the same issues, shared the same dreams and frustrations, but looked at them from a different perspective. Was it the hot weather and the wine, the cosy atmosphere, or the delicious barbecue, or was it just the common need to communicate with the outside world?

**Tom:** “We still don’t know exactly why, but that evening, we decided to start our company OR-AS”.

The combination between academic work, with Operations Research as a methodology, and the IT tools as Applications and Solutions should make them able to translate their ideas into relevant best practices, and should enable them to inspire people to do things better. A new company was born. A company without customers, without a well described idea what to develop and without any clearly defined mission. Only a shared passion in IT and models brought the two together. The time starts to work some things out.

### The start: Search for projects

In 2006, they developed their first software tool, which was a simple standalone tool called “Bouw Assistent” (“Construction Assistant”) to help people manage their cash outflows linked to milestone planning to construct a house. The computer program linked the cash outflows that the customers received on regular bases with the different milestones of the internal project plan used by the contractor. In doing so, the different payments were better understood by the client and better linked to the actual work done by the contractor, avoiding discussions, misinterpretations and even frustrations.

**Tom:** “Our first product was sold in an edition of 40 units, and we bought flowers and a bottle of champagne to celebrate our first OR-AS victory with our families”.

A year later, OR-AS FV was transformed to OR-AS bvba with a mission to develop more products related to project management and control.

### ProTrack 1.0: More than just an ES calculator

After the initial small success of Bouw Assistent, both founders were out for a real challenge: developing a software tool that could make calculations easier, faster and more accurate to manage and control projects of any size. The MS Excel Earned Schedule calculator of Walt Lipke (US) was used at that time by students at Ghent University during a Project Management course, but it was not easy to use due to the limited functionality (it only had a focus on project control, and completely ignored scheduling and risk analysis features, which were also topics that were

discussed in the course). The strength, however, was that the MS Excel file had a simple interface and calculated the ES metrics correctly and lightning fast.

**Mario:** "Our initial idea was to create nothing more than a standalone alternative to the MS Excel file of Walt that could be used by the students and companies involved in project control, but after a few enlightening discussions, we wanted to go a step further".

Many days, nights and weekends later, ProTrack 1.0 was launched in October 2008. As a connection between a strong optimization engine written in C++ and a graphical user interface developed in Delphi, the tool combined standard critical path based scheduling techniques with simple risk analysis tools, integrated in a project control framework, using the standard Earned Value Management (EVM) method as well as the newly developed Earned Schedule (ES) methodology. ProTrack 1.0 mainly consisted of a few algorithms brought together in a GUI without a lot of possibilities to import or export tools. However, it allowed the user to input simple data project files and to calculate earliest start schedules, risk measures and all kind of EVM/ES control metrics.

**Tom:** "ProTrack 1.0 wasn't much more than an extended Excel file with a nice GUI, but it gave the user much more functionality and it gave us room to promote our research results in an illustrative and easy-to-use tool".

From then on, we used the term "Dynamic Scheduling" to refer to the integration between baseline scheduling, risk analysis and project control, and decided that future ProTrack version should focus on the integrative character of these three important Project Management dimensions.

### Extending ProTrack: Integration with a PM Knowledge Center

ProTrack 1.0 was used in Project Management courses at Ghent University and many students relied on the software to analyze all kinds of PM questions in case studies, group works and integration exercises. And ambitious as students can be, they quickly ran on to the limits of ProTrack's first version.

**Mario:** "We stimulated students to criticize our software tool and to provide us with feedback and suggestions for extensions via an online support system, resulting in a wide range of interesting and useful suggestions".

In 2010, ProTrack 2.0 was launched with an elaborate tutorial on the three dimensions of Dynamic Scheduling (Baseline Scheduling, Risk Analysis and Project Control)

and with an extended functionality to optimize the use and scheduling of resources.

**Mario:** "In my PhD, I developed various algorithms to optimize the use of resources in projects, and the biggest challenge was to integrate the best performing procedures into the ProTrack framework".

**Tom:** "With the extended functionality and the increasing number of algorithms, there was an increasing need for a better use of the memory allocation of the software tool, as well as a need for a more flexible use of data generated by the tool".

Step by step, ProTrack slightly moved from a simple EVM/ES calculator to an integrated Dynamic Scheduling calculator that was able to cope with a lot of project data. In 2012, ProTrack 3.0 was introduced with a complete newly designed GUI and an automatic integration with the online learning tool PM Knowledge Center.

**Mario:** "With ProTrack 3.0, we could finally bring our OR-AS mission into practice, i.e. building a bridge between the academic world and the professional PM business world".

**Tom:** "While there are certainly still a lot of opportunities for further improvements, we now offer ProTrack 3.0 as a fully integrated tool, as a window between the user and the PM world, with the extension of the online PM Knowledge Center. ProTrack is no longer a collection of algorithms but now serves as a learning tool to create better understanding into project management and control".

### P2 Engine: Advancing the state-of-the-art research

ProTrack 3.0 is now used at Project Management courses at Ghent University (Belgium), Vlerick Business School (Belgium, Russia) and University College London (UK), with over 300 students per year. Furthermore, ProTrack has also been integrated with the Project Scheduling Game, a business game to give students the possibility to learn basic principles of project scheduling using a software simulation tool. In the game, students have to make decisions during fictitious project progress, trying to bring projects in trouble back on track, given the complex relations between activities, the risk of delays and the impact decisions have on the time and cost of a project.

Thanks to the increasing use of ProTrack in a research environment, OR-AS has created a side product, called P2 Engine, out of the underlying algorithms and procedures used in ProTrack. P2 Engine is an integrated library of dynamic scheduling algorithms that can be used by simple LUA scripting commands to test any research idea of generated project data. P2 Engine is now used by PhD students and master

theses students for testing new ideas in a simple yet challenging environment. In doing so, ProTrack now bridges practical use for students and professionals with a strong and quantitative research integration done at universities by PhD students.

And the students keep coming, year by year, with new ideas, with a critical view on what software should be, with often interesting results using our tools and soon, after graduation, with a newly developed knowledge on PM that they will probably share with the outside world once they enter the real professional world.

You will probably hear from them ... very soon.

# With Stephan Vandevoorde

## A never-ending curiosity and ambition to improve

**“It could be useful to detect research opportunities that can lift up the quality of my business activities.” - Stephan Vandevoorde**

Back in 2001, two people with a totally different background but a shared interest in project management went to a workshop in Antwerp ...

### A workshop ...

**Mario:** “I went to workshops on project management to criticize the so-called best practices in project management. I wanted to show that there is a lot of research available that could contribute to and even improve these best practices. And of course, I wanted to learn how a fit between my research and the best practices could be made”.

**Stephan:** “I visited workshops on a regular basis to learn novel techniques that I could use in my daily practice. I also wanted to illustrate that my practical experience could be relevant to improve the current way of thinking, and could be useful to detect research opportunities that can lift up the quality of my business activities”.

Despite their different background, the main reason why they visited the workshop was to learn from the existing methods and to show that they could be improved. And above all other reasons, they were both at the workshop out of curiosity and from a deep passion to improve the current way of working in project management.

The two exchanged their business cards, to throw them somewhere and never look back, as is usually done. But the next day, Stephan decided to call Mario with a request to exchange ideas and think about a joint project, one way or another. Although none of them had exactly an idea how their experience could be matched into a joint project, they both knew that they had one thing in common: a never ending curiosity and ambition to improve the current project management way of thinking.

They both truly believed in the symbolism between research and practice.

**Mario:** “I was convinced that many research results could be used in a practical setting, and was eager to meet professionals who shared the same ideas and wanted to collaborate to work things out”.

**Stephan:** “I always believed that understanding results from research endeavors is the ideal tool to enhance my knowledge, and I was therefore constantly looking for people with a strong academic background, but with a deep interest to translate this research in relevant best practices”.

### Schedule risk analysis at Brussels Airport

After a few months, the two already started to run Monte-Carlo simulations to measure the impact of unknown and unexpected events on the performance of the luggage handling system in Zaventem at Brussels airport.

**Stephan:** “These were exciting times for both of us, since we saw that the combination of my data and the techniques developed at Ghent University allowed us to better understand the behavior of the luggage handling systems”.

The two developed their first simple schedule risk analysis tool, in a straightforward MS Excel environment with some VBA coding.

**Mario:** “After a short time, we ran simulations with our Excel software tool for other projects. It was fun, but we quickly wanted more”.

### First paper and London visits

The two became close friends, and they wanted to extend their work and share their results with others to reach a broader audience. Therefore, they started to focus on “dynamic project scheduling” and extended their focus on the integration between constructing schedules and developing project control systems, rather than focusing only on schedule risk analyses. They made use of the Earned Value Management (EVM) technique to monitor and control projects and had the ambition to extend and improve the EVM technique using research results from literature.

**Mario:** “The problem was that, apart from a couple of white papers in the US, there weren’t a lot of EVM research results available in the literature. And the literature on the integration between project

scheduling, risk analysis and project control was completely void”.

In 2004, they decided to run an extensive simulation experiment using the Fabricom data as well as fictitious project data, in order to validate and benchmark the current EVM systems based on a sound and academic method.

**Stephan:** “We promised to each other not to use project control systems in our projects if we didn’t know how and when they work or fail. And research was an ideal tool to validate, and even improve, current systems”.

### First paper in 2006

From 2005 on, the two regularly visited London to show their preliminary research findings during workshops, since they believed that this was the only way to meet other people involved in huge projects with an interest in research. On one of the workshops in London, they met Walt Lipke (US) and Kym Henderson (Australia), who were presenting their “Schedule is different” article from 2003.

This encounter was the start shot of putting their research minds into reality. Walt was presenting his new Earned Schedule technique as an improved version of the Earned Value Management technique, and while some attendees were sceptic about it, Walt was convinced that it was the only approach to control the timing of the projects.

**Mario:** “This debate between the believers and non-believers of Earned Schedule, often based on very subjective feelings and vaguely described statements, was the ideal opportunity to start up an extensive simulation study to quantify the advantages and disadvantages of both techniques”.

**Stephan:** “Our aim was not to promote ES and/or EVM, but rather to provide an objective validation and comparison that could be useful for professionals who wanted to use one of the techniques”.

A year later, our first article was published in the International Journal of Project Management. Soon after the publication, the board of PMI Belgium expressed their interest in our work and organized a session for us, in collaboration with Walt and Kym. After that evening, the first plans were made to work together, and to join our Belgian efforts with the work done at the US and Australia. Walt and Kym became partners in our shared dream to lift up the project management discipline.

### Outside Belgium and more

Ever since, Mario and Stephan have done a lot of effort to bring their project management research results to

a broader audience. In 2008, the International Project Management Association (IPMA) recognized their collaborative work with a research award in Rome (Italy). Since their collaboration with project managers and researchers from CERN (Switzerland) and their yearly event at EVM Europe, more and more people get involved and believe that a bridge between the academic world and the professional business contributes to the field of PM.

**Stephan:** “Probably the biggest impact we had on the outside world was with the keynote presentation we gave at EVM World in Florida in 2012 with the presentation “If Time is Money, Accuracy Pays Dividends: An Overview of Past and Future Project Management Research””.

**Mario:** “Our presentation created a certain awareness that companies, universities and business schools can work together and can, through joint efforts, narrow the gap between the PM theories and the practical needs.

Years after the Antwerp workshop in 2001, the story continues ... a story about the transformation from two enthusiastic people trying to find a connection to two close friends working together. A story about a never-ending curiosity and an ambition to enhance, connect and share the project management knowledge available in the academic literature and the practical experience.

# With Jean Pierre Tollenboom

## Integrating dynamic scheduling and dynamic project control

**“If we don’t show our youngsters how to assess and control a project, how can we expect that our future generation will do better than ours?” - Jean Pierre Tollenboom**

### EVM Europe

As a mechanical engineer from Ghent University with a deep passion for everything that is quantitative and with an immense track record and experience in Project Management, Jean Pierre Tollenboom was a speaker from the very beginning at the EVM Europe conferences. Every year, Jean Pierre gave a presentation in the academic track on his Dynamic Project Control (DPC) system developed at his company Claymore-Lowlands, hoping to inspire and get inspired by novel ideas from researchers trying to find a way out of the academic world.

**Jean Pierre:** “The most interesting aspect about EVM Europe is its research meets practice mission. Unlike many other conferences that bring best practices and case study stories, the ambition of EVM Europe is to bring novel ideas to the real world”.

**Mario:** “This was exactly the reason why I was so passionate about EVM Europe from the very beginning. The yearly preparations for each conference take a lot of work, but when meeting someone like Jean Pierre, you know that the hard work pays off”.

From the first EVM Europe conference in Geneva on, Mario and Jean Pierre shared their common passion on quantitative modeling in project control settings. While OR-AS was in the middle of the development of their second ProTrack release, the DPC development efforts focused on online integration and user communication. Two separate systems for one unique goal: making project management and control better.

Each year, the two showed their progress on the EVM Europe conferences and promised to merge their efforts into a single and improved control method, but it took them until 2010 to establish their shared passion into a friendship and partnership between OR-AS and Claymore-Lowlands.

### Dynamic what?

**Dynamic Scheduling** is a term borrowed from literature to refer to the need to integrate project scheduling, risk analysis and project control. The research done during the writing of “Measuring Time” and the development of this integrated approach in ProTrack has shown that the real purpose of baseline scheduling and risk analysis is to act as a point-of-reference for dynamic project control.

**Dynamic Project Control** is a term to refer to the dynamic nature of controlling projects as a tool to trigger warning for corrective actions. The methodology is based on a cloud based closed feedback control mechanism that allows project managers to upload their DPC compliant planning in a PM software tool, like ProTrack. The tool can immediately be consulted online or via Interactive CDF (Wolfram’s Computable Document Format) which will be e-mailed to the user.

### Approach

Although both ProTrack and DPC have a focus on improved project control using performance management metrics, they also have their own strengths and weaknesses. While ProTrack has its main strength in the efficient calculation engine on scheduling, risk and control embedded in the Delphi written GUI, DPC has a strong focus on the online integration and the communication with the user using Mathematica.

**Mario:** “We agreed that we could remove the shortcomings of both methods by focusing on their specific strengths and combine them into an integrated method. I believe that this is exactly the path where research can meet practice!”

**Jean Pierre:** “We were convinced that the combination of both methods by exploiting their strengths would bring us to a better fully integrated project control

mechanism that outperforms both individual approaches, and therefore, we decided to give it a go”.

**Tom (OR-AS):** “I wrote an interface between both systems to facilitate data exchange which allowed us to test the performance of the integrated method in a research environment”.

While the system is still in a testing phase and continuous improvements will be made before putting it in the commercial circuit, the joint efforts from the ProTrack/DPC team show that passion for research and interest for business can lead to better integrated systems for project management and control.

### **Business and education**

Although the primary focus of the ProTrack/DPC collaboration is to stimulate the relevance of the new integrated project control tool for business used by PM professionals, initial tests have been set up to use the integrated method in a teaching environment.

**Jean Pierre:** “If we don’t show our youngsters how to assess and control a project, how can we expect that our future generation will do better than ours?”

**Mario:** “The joint efforts on education are still in a premature stage to show overwhelming results, but we see a great potential and a lot of opportunities for using the system in an educational setting”.

Two companies, two products, a shared interest and a joint passion for models, IT and Project Management have finally led to an ProTrack/DPC collaboration where the mission is, and always will be, to bring research closer to practice. To be continued.

# With Walt Lipke

## From emerging insert to best practice

**“Research goes hand in hand with trying and failure, and even the failures have to be seen as a search for something new, and not as waste.” - Walt Lipke**

Back in 2003, a deputy chief of the Software Division at Tinker Air Force Base from Oklahoma wrote an article **“Schedule is different”** in the Measurable News that raised the interest from two Belgian guys and one Australian, and that was the beginning of a great adventure ...

### Schedule is different

In the years prior to 2003, Walt Lipke was in search of something new... Measuring the time performance of a project using Earned Value Management (EVM) was until 2003 done using the so-called Schedule Performance Index (SPI) which was flawed towards the late stages of the project. And although many were aware of this quirky mistake, it was Walt who used this flaw to present an extension of the SPI using a novel concept, now known as Earned Schedule (ES).

**Walt:** “The new Earned Schedule concept allowed me to redefine the flawed SPI into an alternative SPI(t) which was correct from the start till the end of the project. I thought that presenting this idea in a paper would not lead to much commotion or interest, but at least it would correct an error in EVM.”

He probably didn't realize what an impact the article would have on his own life, and on the life of many others. It was 2003, and at that time, the collaboration between Mario at Ghent University and Stephan at Brussels Airport reached a peak, mainly consisting of schedule risk simulations and preliminary attempts to better control project performance [See article: “With Stephan Vandevoorde: A never-ending curiosity and ambition to improve”). None of them had ever heard about Walt Lipke and its new little article in the Measurable News.

**Mario:** “During my collaborations with Stephan on schedule risk and project control, we both felt the need for a more sound methodology, and I knew that academic research could deliver this. But for an unknown reason, we needed a trigger to start up such a research track”.

**Stephan:** “The article of Walt in the Measurable News attracted my attention, and although I was somewhat skeptical about the performance of the newly presented Earned Schedule, we started to think about a way to validate it and compare this novel idea with the existing alternatives.”

It didn't took long till Mario and Stephan got in contact with Walt via email asking all kinds of questions on how to use this new Earned Schedule technique proposed in “Schedule is different” into the current EVM methodology and research. The initial preliminary tests on the novel ES concept done at Ghent University quickly resulted in the first peer-reviewed paper that was presented at various workshops and conferences across the world, and was finally published in 2006 in the Journal of the Operational Research Society. From that moment on, something changed in the life of these three people.

### Exposure: From emerging insert to ...

Initiated by Walt's first seminar article, and supported by the on-going academic peer-reviewed articles written at Ghent University, but also motivated by the enthusiasm and real data provided by Kym Henderson (who was at that time working together with Walt), there was no speed limit anymore on the work we did.

**Stephan:** “Ever since the first article in the Measurable News, and our more academic peer-reviewed articles, the initial email communication changed to phone calls and regular meetings around the world.”

Rapid increase of research results and increasing awareness of the value of Earned Schedule forced Walt, Kym, Mario and Stephan to meet on a more regular and formal basis, leading to regular visits in London (UK) and Brussels (Belgium) to give joint lectures and presentations, but also to visits in other European countries.

As the adoption of Earned Schedule grew by a larger number of people, the collaborations became more intense and professional. Two books were published ("Measuring Time" by Mario and "Earned Schedule" by Walt), and the software tool ProTrack was developed. ProTrack was undoubtedly one of the first software tools embedding ES, and this was promoted from the very first hour on Walt's Earned Schedule website ([www.earnedschedule.com](http://www.earnedschedule.com)). At the professional front, PMI quickly decided to pay attention on the novel ES concept. The PMI Practice standard for EVM (first edition) was published in 2005, and included it as an "emerging practice insert" (although it did not mention Earned Schedule by name). The second edition, published in 2011, included "Schedule Analysis using EVM Data" at Appendix D.

**Mario:** "We were just like the three musketeers, but then consisting of four people, trying to spread a message on project performance and control across the world. When there was something going on in EVM, at least one of us was there, but many times, the four of us were present."

**Kym:** "These meetings were interesting from various points of view. It was on one of these regular meetings that I launched the idea to set up a European organization EVM Europe. It was just an idea then, and I didn't intend to set up a growing organization."

### Collaborating, and more...

At EVM Europe, Walt was there from the very beginning on our first meeting at CERN (Switzerland), and he continuously joined us at the follow-up editions in Belgium, Spain and the Netherlands, always with interesting presentations on his new ideas for students, researchers and professionals.

**Mario:** "There is no doubt that we all learned more from Walt than only Earned Schedule. One of the most important lessons that I personally learned was to work hard, make decisions, never quit, but above all, enjoy everything you do!"

And we did. We had good times, with lots of work the evenings before the presentations on workshops and conferences, but lots of fun the evenings after. We learned that letting an Australian taste more than five different flavors of Belgian beers is not a good idea if you need him the next day, or walking around in Valencia and having dinner in a randomly selected Spanish fish restaurant is probably something we will never do again. And... ah, there's so much to tell...

**Mario:** "Walt was not only an initiator of my EVM research that has eventually led to the publication and award of "Measuring Time" in 2008, he was also an inspiration for future research and follow-up collaborations. But above all, he gradually became a friend who I truly respect."

Out of that respect, the board of EVM Europe decided in 2013 that the time was right to shed some light on this interesting collaboration between Europe, USA and Australia that all started with a short article.

### 2013 Award

The workshop edition of EVM Europe in 2013 was the ideal occasion. At this fifth edition, there were quite some reasons to celebrate, among others:

- The fifth anniversary of EVM Europe, including collaborations with the College of Performance Management from the USA.
- At this edition, 17 master and PhD students presented, for the very first time, preliminary results of the 'more than a million' euro project (see article "Concerted Research Action: Demonstrating scientific excellence through collaborative efforts")
- The workshop was concluded with a celebration ceremony for Walt, 10 years after his seminal paper that has led to this EVM Europe organization. The ceremony contained a presentation given by Mario with a flashback on 10 years of hard work and fun, including an award attribution to Walt.

And the story continues... There are still a lot of plans to further enhance the EVM/ES discipline. Better workshops, more books, academic papers, new teaching material, and much more. Many of these endeavors will be discussed elsewhere in this book, but it all began with four enthusiastic guys and an at that time unnoticed paper.



Awarding Walt at the EVM Europe 2013 conference  
(December 4, 2013, Ghent, Belgium)

# With EVM Europe

## The yearly conference where research meets practice

**“The conference helped me gain greater awareness of the life that EVM has on its own, outside of the United States defense sector.” -**

Testimony of an EVM Europe 2012 attendee



### EVM Europe

EVM Europe is an organization to showcase integrated project control best practices and novel research activities to Europe. It aims at bringing practitioners as well as researchers together to share their knowledge and exploit opportunities. The global aim of EVM Europe is to increase the use of EVM and to stimulate and challenge both project managers and researchers to go in discussion, aiming at bringing the current state-of-the-art knowledge to a higher level.

### History

EVM Europe has initially been founded in Switzerland in 2009 as EVA Europe, and was re-founded in 2011 in Belgium as EVM Europe. In 2008, on a dinner after one of the London workshops attended by Mario, Tom (see article “With Tom Van Acker”) and Stephan (see article “With Stephan Vandevoorde”), discussions with Kym Henderson (Australia) and people from CERN (Switzerland) on a new endeavor to bring researchers closer to practitioners have led to the idea of creating an association that organizes yearly conferences on project management and control.

It was Kym’s idea to have an alternative to the American EVM World to showcase and promote integrated project controls to Europe. It was a need expressed by Mario and Stephan to have a unique focus in the organization, which would be translated in a close connection and collaboration with Ghent University and its research group on Project

Management. After a few discussions on fine-tuning details about the theme and mission, the idea was to organize yearly events to bring researchers and practitioners together in the neighbourhood of a university with a strong research profile and exposure on Project Management. Up to today, the collaboration has led to a first edition of the yearly conference in Geneva (Switzerland, 2009), followed by Ghent (Belgium, 2010), Valencia (Spain, 2011), Twente (The Netherlands, 2012) and Ghent (Belgium, 2013). For more recent updates, the reader can visit the press articles at PM Knowledge Center.

### Mission

The mission statement of EVM Europe is "Research meets Practice". The mission becomes very transparent at each conference thanks to a dual presentation track: one track focuses mainly on practitioners and another one is specially made for academics. At our previous conferences, we saw that the academics visit the practitioner track and the practitioners visit the academic track. And that is exactly the mission: we aim at bringing practice closer to research and research closer to practice.

EVM Europe is not just an organization to bring practitioners together to tell what they did, what went wrong and what was so wonderful about the management of their project. Conferences with case studies and best practices can be found all over the world, but the focus of EVM Europe lies at bringing practitioners together with a critical and open mindset, experienced project managers who dare to criticize their own approach and want to share their ideas with other professionals and academics. EVM Europe aims at sharing knowledge, even if it comes from failures or less successful projects, learning from each other, criticizing each other and helping each other to do better, with only one goal in mind ... bringing Project Management at a higher level, bit by bit, year by year.

That is why it is believed that the academics can play an important role in this mission. They inspire practice, and - at the same time - are inspired by practice. Research at EVM Europe is not done in an isolated world but is based on experience from the professionals and needs from the real world. Therefore, EVM Europe's academic track is not a theoretical track. It is a critical view to the outside

world and it is open to everyone, academics as well as practitioners.

### Theme

Controlling projects using Earned Value Management has become a standard in managing and measuring the performance of project portfolios. It has been used for both large and small projects in various sectors, and has been subject to a lot of research. However, despite its widespread use, there are still major opportunities to further enhance the knowledge of this project management control system.

Although the abbreviation "EVM" in "EVM Europe" is used to refer to Earned Value Management, it does not mean that we only include presentations about Earned Value Management. On the contrary, EVM Europe's conference is not solely an EVM conference, but rather a conference focusing on "integrated project control". This includes but is not limited to EVM topics. Instead, the main focus lies on an integrated project life cycle approach and includes themes such as project design, baseline scheduling, risk management, project control, performance measurement, project maturity models and much more.

### Anniversary

In 2013, EVM Europe reached an important milestone and celebrated its 5<sup>th</sup> anniversary in Ghent (Belgium). There were lots of reasons to celebrate. First of all, 2013 was the 1<sup>st</sup> year of the "more than a million euro" research project and preliminary results could be presented at the event by 4 PhD students.

Moreover, growing from a small organization with a few friends to a community of professionals and researchers in only 5 years is something that makes us proud. And in Belgium, being proud is celebrated by French fries (French fries are not from France, but from Belgium!) and beer. It's the way we celebrated the 5<sup>th</sup> event.

2013 was also the ideal occasion to celebrate the work of Walt Lipke. 10 years after his seminal paper

on Earned Schedule, the time was right to give that milestone a central place at EVM Europe by handing over an award for the excellent work done.

The collaboration between EVM Europe and EVM World with the keynote speech of Mario Vanhoucke and Stephan Vandevoorde at EVM World 2012 and the help of friend and colleague Kym Henderson has strengthened the relations between Europe and the US, which was another reason to celebrate our growth inside but also outside Europe.

And finally... we had our special sessions. In 2012, we had our first and successful special session on "**Business Games in Project Control**". In 2013, we organized a special session with only young people. At least 15 Master Students of the Faculty of Economics and Business Administration from Ghent University have joined EVM Europe in a special session on "**Young Researchers in Project Management and Control**".

"Young people are fitter to invent than to judge,  
fitter for execution than for counsel,  
and more fit for new projects than for settled business"  
**Francis Bacon**



The EVM Europe board, from left to right: Jurgen De Jonghe, Dr John Ferguson, Prof Dr Mario Vanhoucke, Ing Stephan Vandevoorde, Kym Henderson, Prof Dr Pierre Bonnal  
(December 29, 2012, Twente, The Netherlands)

# With College of Performance Management

## Joint forces between Europe and the US

**“The Memorandum of Understanding is a significant step forward for both CPM and EVM Europe which will lead to future opportunities for collaboration and perhaps even joint initiatives as we undertake our respective missions of advocating the adoption and advancing the practice of EVM globally.” - Kym Henderson**

The **College of Performance Management** (CPM) and the **EVM Europe** Association (EVM Europe) share a mutual commitment to excellence in learning and strategic collaboration for the development of best practices in estimating, cost engineering, scheduling, performance management, earned value management and associated techniques, collectively known as "Integrated Project Management and Control" within industry, government and other organizations.

A **Memorandum of Understanding** formalizes an ongoing relationship with the objective of continuing to support each other's efforts to leverage the best practices of the project controls community in terms of earned value management and associated project control techniques.

Such a memorandum establishes the framework for CPM and EVM Europe to pursue opportunities that are mutually beneficial and to work together on enhancing existing efforts. CPM and EVM Europe will each appoint a 'sponsor' to explore these opportunities and propose the specific details on what each party will pursue and how the details associated with each should be handled.

### Opportunities

The opportunities identified for partnering include but are not limited to the following:

- Encourage participation, as volunteers, in CPM and EVM Europe sponsored workshops, committees, working groups, panels, and boards designed, among other areas, to identify earned value management related trends, future training needs, and methods of recruiting and retaining project controls professionals within government and industry.
- Provide complimentary exhibit space at each other's conferences.
- Explore the possibility of holding jointly sponsored EVM Europe and CPM conferences, seminars or meetings.
- Extend members the courtesy of registration at each organization's conferences, symposia, meetings, seminars, and other events.
- Offer each organization's office one complimentary exchange subscription to each organization's journals or magazines.
- Recognize and publicize the Memorandum of Understanding, and agree to use each other's publication media to exchange information regarding project controls events and items of interest.
- Publicize meetings, seminars, and symposia sponsored by CPM and EVM Europe and publish their calls for papers.
- Exchange trade-outs and/or discounted rates for advertising in each organization's directory and publications.

### MEMORANDUM OF UNDERSTANDING

Between the  
EVM Europe Association  
and the  
College of Performance Management

Signed and Accepted by

Mario Vanhoucke  
President  
EVM Europe Association  
&  
Gary Troop  
President

College of Performance Management

March, 2014

# With José Coelho

## About research and passion

**“I've got two places I like to be. Portugal is one.” - Cliff Richard**

No doubt ... for me, Lisbon is one of the most beautiful cities of the world. With its series of hills running down to the grand Tagus River, its colorful, picturesque streets, its strategically-placed viewpoints or terraces and its wide variety of food, I cannot think of a better place to combine work with pleasure. And yet, despite the many hours of sunshine during the day, the variety of interesting people and the nice views, I spend most of the time with my friend and colleague, José Coelho, somewhere in an old university building ... doing research.

### José Coelho

Colleague and friend José (his full name is José Pedro Fernandes da Silva Coelho) is a professor at the Department of Sciences and Technology from the Universidade Aberta, and member of the laboratory of Artificial Intelligence and Decision Support of the Institute for Systems and Computer Engineering - Technology and Science (INESC TEC). This centre focuses on decision support systems with special emphasis on data mining, forecasting, adaptive modeling and optimization with applications in marketing, finance, process scheduling, health, text information retrieval and many other areas.

I have met José in 2002 in Valencia (Spain) on a PM workshop. Ever since, we have collaborated in various ways, and have experienced many interesting meetings and joined work sessions in Belgium, Portugal, Spain and Germany. Below, a summary is given of our main achievements of a collaboration that now already lasts for more than a decade.

**Network generation:** On our first acquaintance on the Spanish workshop, we quickly decided to start up a research collaboration on a joined research interest to generate project networks in a random way. The expertise gathered in my previous research study on the RanGen generator (Journal of Scheduling, 2003) and the José's RiskNet generator (European Journal of Operational Research, 1998) has been used to develop a new generator RanGen2, that has been

published as our first joint article under the title “An evaluation of the adequacy of project network generators with systematically sampled networks” (European Journal of Operational Research, 2008). This network approach is used as the foundation for generating networks in P2 Engine (see “Products”).

**Machine scheduling:** Thanks to the close similarity between project scheduling and machine scheduling, research on machine scheduling always has had a central place in the Operations Research & Scheduling group. The collaboration with José has therefore also resulted in a publication entitled “Hybrid tabu search and a truncated branch-and-bound for the unrelated parallel machine scheduling problem” (Computers and Operations Research, 2015).

**Satisfiability:** The Boolean Satisfiability Problem, abbreviated as SAT, is the problem of determining the existence of an interpretation that satisfies a given Boolean formula. The set of logical equations and solution procedures to solve these challenging problems originates from the Computer Science world, and has been adapted to be used in project scheduling. Our efforts have led to the publication “Multi-mode resource-constrained project scheduling using RCPSP and SAT solvers” (European Journal of Operational Research, 2011). In Lisbon, we have carried out research on solution approaches to solve the resource-constrained project scheduling problem with logical constraints which is published as “A new solution approach to solve the resource-constrained project scheduling problem with logical constraints” (European Journal of Operational Research, 2016).

**Project data:** Given our affinity with network generators to create artificial datasets, and the availability of real project data in the OR&S, we started working on a paper aiming at bringing all the current knowledge together. This research has resulted in a paper entitled “An overview of project data for integrated project management and control” (Journal of Modern Project Management, 2016) which we have written in Lisbon in 2015. Further plans to extend this work are on the research agenda.

## Lisbon 2015 & 2016

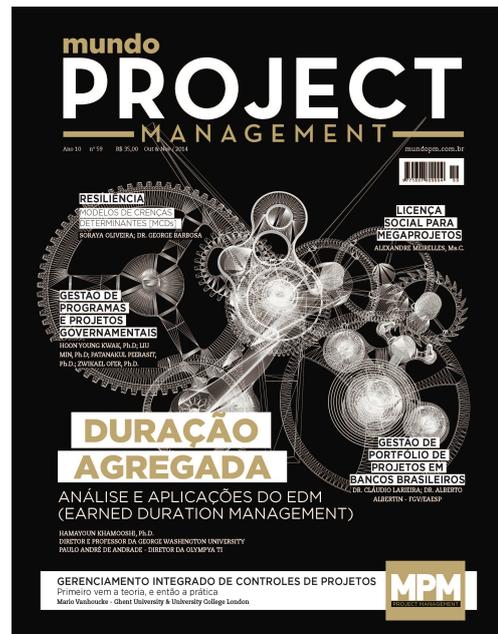
Despite our past achievements and the proud and satisfaction we feel for the past years, we both believe that the best is yet to come. In May 2015, I have moved to Lisbon for a few months to extend our collaboration on the SAT research. The plan was not to enjoy the good life on the beautiful terraces outside, but instead to lock ourselves into the dark ivory tower of research with occasional company visits to validate our results, and all that with only one mission: continue the SAT research we did in the past, but now 10 times faster and more intense. It was a wonderful experience. It resulted in a few papers mentioned earlier. In 2016, I repeated that experiment, and moved to Lisbon again. We worked on new research, which is still in progress. And that's not the end. In 2017, José Coelho will move to Ghent for some time to continue our challenging work. Yes, that is research ... we stay hungry, we stay foolish.

## Portuguese all over the world

In anticipation of my stay in Lisbon in 2015, I have written my first Portuguese publication on Dynamic Project Management and Control. The article is a summary and overview of the book "Integrated Project Management and Control: First comes the theory, then the practice" published by Springer. During my stay in Lisbon in 2015, I wrote a second Portuguese article "introdução à duração agregada" published in the same journal.

Both articles are published in **MundoPM**, a Brazilian Project Management journal ([www.mundopm.com.br](http://www.mundopm.com.br)), and although they are originally written in English, they have afterwards been translated in Portuguese and published by colleague Osmar Zózimo, executive editor and publisher at the MundoPM and the Journal of Modern Project Management.

Both the English version as well as its Portuguese translation of the first Brazilian article "Gerenciamento Integrado de Controles de Projetos: Primeiro vem a teoria, e então a prática" are available at the website mentioned below the picture.



Mundo Project Management  
(Oct. - Nov., 2014 issue)  
([www.or-as.be/blog/mundopm14](http://www.or-as.be/blog/mundopm14))

# With Paulo de Andrade

## Better late than never

**“The time for action is now. It's never too late to do something.” - Antoine de Saint-Exuper**

### First acquaintance

I have met Paulo for the very first time live during my visit in Brazil (cf. other article). I had been in email contact with him for a few months, since he was interested in using the empirical database for exploring new ideas. I had no idea what his age was, and I expected a young guy at the beginning of this exploration of the research world. I quickly noticed that he was a little bit older and much more experienced, but above all, I immediately saw that he was a friendly, nice and inspiring person. So I answered most of his mails.

After some time, he started translating parts of my books in Portuguese, and asked detailed questions about every little topic. Paulo never stopped questioning, exploring, and wondering. Maybe he should do some research?

And then, in 2016, I gave a workshop in São Paulo (Brazil) and Paulo was in the room. During the break, we had our first chat, and that was the start of our collaboration. Life is strange... Most of the time you meet people, talk to them for a while, and then forget what you said or promised, but occasionally, some of these meetings go straight to the heart. That was the case with Paulo.

I learned that Paulo had an impressive career at Techisa do Brasil Ltda. He is a retired electronic engineer with experience that spans over 25 years, responsible for projects at IBM and R&D projects. At the end of the break, I quickly said: “Why don't you try to do real research?”

It was just a thought.

### First writings

I have a lot of respect for Paulo. Not only for his hard work, but also for the way he keeps analyzing things until he fully understands them. But above all, Paulo is an amiable guy. He's now in the midst of his 70s, but with an energy of a young graduate student.

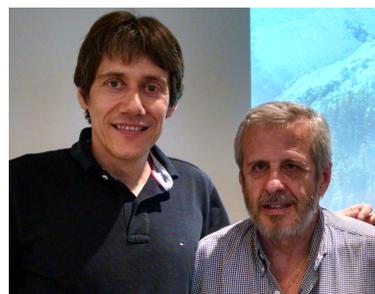
After some time and a thousand emails back and forth, we finished our first paper “Introduction to earned duration” published in the Measurable News (2015) and a Portuguese translation of it published in Mundo Project Management. Not bad for a first start, but still not very academic.

### More academic

With our second paper, we wanted to aim higher. Aiming at new results, with a sound methodology, in order to reach an academic journal with a peer-reviewed process, that was the challenge.

We initially submitted a draft of our second paper to the well-known International Journal of Project Management, but the editor decided to reject the study since it didn't contain enough novelties to warrant publication. It was a fair decision. The topic was interesting, but we were not ready yet for a 100% academic paper.

We continued our work, updated the paper and finally published “Combining EDM and EVM: A proposed simplification for project time and cost management” in the Journal of Modern Project Management in 2017.



With Paulo André de Andrade  
(São Paulo, Brazil in 2016)

### Next steps

But Paulo's (and my) ambitions reached higher. We decided it was time trying to reach a real academic journal. With our third paper “Using real project schedule data to compare earned schedule and earned duration management project time forecasting capabilities”, we finally had our acceptance in the journal “Automation in Construction”. Well done Paulo!

To be continued, I hope.

# With experts from the field

## The critical eye of the jury

**“You never know with juries. I’d take a judge every time, unless of course I was guilty.” - Kenneth Eade**

and they act as a reviewer for the work done. Their critical comments and suggestions are crucial to guarantee a high-quality delivery of work to the scientific community.

The PhD defense is a crucial step in the life of a PhD student. On that day, the topic of study is presented to a team of experts, the jury. They are supposed to have a critical view on the presented work, they should ask the difficult questions to test the student's knowledge



**Pierre Bonnal** (CERN, Switzerland)

I work with Pierre ever since the launch of EVM Europe, and with his practical experience of managing complex projects, his contribution was necessary for the PhDs entitled “Time/cost optimization and forecasting in project scheduling and control”, “Improving decision making for incentivised and weather-sensitive projects” and “Single and multi-variate methods for statistical project control using earned value management”.



**Tyson Browning** (Texas Christian University, USA)

The expertise in project and portfolio management made Tyson a welcome jury member for the PhD entitled “Improving decision making for incentivised and weather-sensitive projects”. Through his practical experience from his MBA teaching and his excellent research, he could see through the equations of the study and ask critical questions about the relevance of the study and its potential impact on project portfolio management.



**José Coelho** (Universidade Aberta and INESC-TEC, Portugal)

The collaboration with José dates back from 2001 and has resulted in multiple joint publications. During my stay in Lisbon, we made several plans for future research on project scheduling and project data. He has been a necessary jury member for the PhDs entitled “Meta-heuristic procedures for the multi-mode project scheduling problem” and “Heuristic algorithms for payment models in project scheduling”.



**Öncü Hazir** (Ted University, Turkey)

Jury member Öncü has expertise in both time/cost trade-off scheduling and project control using earned value management, and has therefore been the ideal jury member in the PhDs entitled “Time/cost optimization and forecasting in project scheduling and control” and “Empirical evaluation of existing and novel approaches for project forecasting and control”. He has joined EVM Europe and presented his work in the Ghent 2010 edition.



**Young Hoon Kwak** (The George Washington University, USA)

With a similar background on project management and control, it was an obvious choice to assign Young to our department of Ghent University. As a member of the OR&S group, he has been part of the jury for the PhDs entitled “Empirical evaluation of existing and novel approaches for project forecasting and control” and “Single and multi-variate methods for statistical project control using earned value management”.

# With students all over the world

Share and get involved

**“A student of life considers the world a classroom.” - Harvey Mackay**

ORASTalks is the app about Project Management and Decision Making for and by students and professionals, and is used during the teaching sessions at universities, business schools and company trainings across the world (cf. the ORASTalks app page in this book under the chapter ‘Products’). At its introduction date in 2013, ORASTalks was only available for iOS and Android, and in November 2014, it has been put available for Windows Phone users. Since its introduction, it has been used by students all over the world to stay up to date with the latest developments, and to share content between schools and countries. In 2016, the ORASTalks app has been removed from the app stores and replaced by a Facebook group. Join this group!

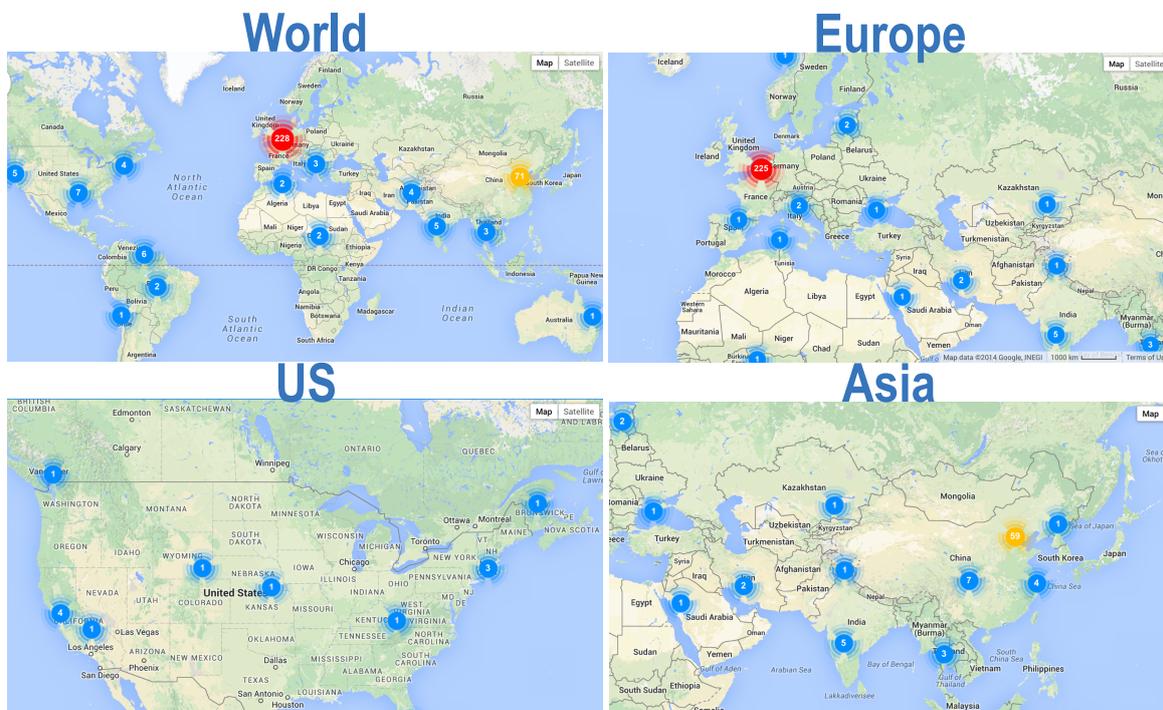
[www.facebook.com/groups/ORASTalks](http://www.facebook.com/groups/ORASTalks)

## The world map

The initial idea was to communicate with my Belgian students, but soon other students and professionals started to use the app as their tool to get in contact with me and my team. Below it can be seen that the epicenter of the ORASTalks downloads lies in Belgium and in China, which is where I mostly teach, but other places that I have visited (and not visited) are also on the download map. The maps clearly show the spread of downloads, and hence the interest in Project Management and Decision Making, all over the world.

## Without the app

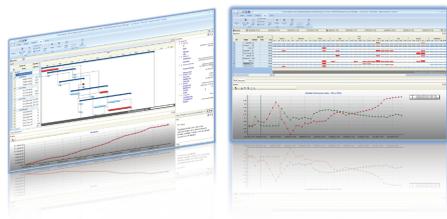
Students and professionals can still follow our research activities on the Facebook group or at the OR-AS website. Just visit [www.or-as.be](http://www.or-as.be).



ORASTalks on the world map (Nov., 2014)

[www.or-as.be/blog/orastalks\\_3](http://www.or-as.be/blog/orastalks_3)

# Products



# OR-AS

## Operations Research - Applications and Solutions

### IT as an interface between research and the outside world

#### Nice to meet you, what can OR-AS do for you?

OR-AS is an acronym for Operations Research - Applications and Solutions and is mainly active in the field of Project Management. As a collaboration between an academic and an IT expert, the company aims at providing answers on the question how single project and multi-project management processes can be integrated in the current company processes.

Founded in 2007, as an extension of their first partnership (OR-AS was initially created a few years earlier under a temporary partnership), the founders develop decision support software systems that make use of academic methods fine-tuned and adapted to project and sector specific characteristics, with the mission to translate academic research results into accessible tools and guidelines for best practices.

OR-AS is founded from a deep desire and motivation to bring academic research results alive in the professional world. The motivation to fill the gap of existing software tools and methods and the desire to fine-tune current methods to the wishes and needs of professionals, our clients, is what drives the OR-AS members in all their activities.

#### From research to practice, and back

The OR-AS approach is a cyclic approach that relies on academic research as initiator to develop successful products that can be integrated in current company processes and cultures and the feedback loop back into the academic world as an inspiration to tackle new challenges.

#### Products

In the next pages of this chapter on the OR-AS products, an overview will be given of the main products created to be used for Project Management purposes in research, business and/or education.

ORASTalks is the app that aims at bringing students, researchers and professionals together to share content and novel ideas on Project Management.

Various project management books are available in the OR-AS bookstore to communicate with researchers, students and professionals. The attentive reader of the previous editions of this book will notice that I have removed my book promotion page from the “products” part in the 5th edition. I have decided to move all the book material to a separate part of this book called “books”.

The software tool ProTrack is a project management tool that brings dynamic scheduling on your desktop.

The Project Scheduling Game is a project scheduling and control business game integrated in ProTrack to learn skills to project managers, students or professionals.

PSG Extended is an extension of the Project Scheduling Game that focuses on the underlying solution approach/mechanism taken by participants who have successfully played the Project Scheduling Game.

PM Knowledge Center is a free and online learning tool accessible via the ProTrack welcome screen or just by visiting the PMKC website. It provides a knowledge shelf on dynamic scheduling as a tool that can be used in university courses, company trainings or distance learning.

P2 Engine is the advanced research tool that enables users generating a lot of simulated data in order to test research hypotheses and to advance the state-of-the-art knowledge.

ProXL is a spreadsheet based project planning and control tool written in MS Excel. It is used for solving case studies and contains a planning module, a risk analysis module, a monitoring module and an integrated dashboard for top-down/bottom-up project control.

In 2018, we decided to stop working under the OR-AS bvba structure and go for the next step. We opened our horizon and joined forces with partners in Belgium and the UK. The acronym OR-AS will continue to be used for communicating and sharing our research and consultancy endeavours, and we will keep you up to date about our beautiful and powerful Project Management products.



Each development cycle starts with academic **research** at Ghent University, in collaboration with Vlerick Business School and international universities in the UK and the US. Research is seen as a driver for developing new methods and approaches to better control projects, and is often started years before the real software development.

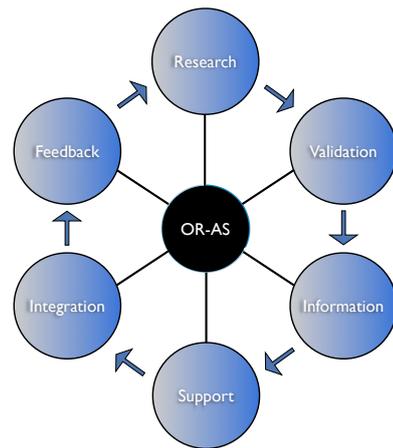


The **validation** of the newly developed procedures and techniques consists of a dual approach. In a first research based approach, numerous extensive computational experiments are carried out on a supercomputer using a lot of real and fictitious data. During these experiments, the new techniques are validated and benchmarked against the current existing solution approaches. The P2 Engine as a research derivative of the commercial ProTrack tool is the driving force for these experiments. In a second run, the newly developed techniques are validated in a practical environment using real project data coming from our collaborations with business professionals.



Research results are often complex, using state-of-the-art methodologies and are published in high-quality academic journals. In order to exploit this research strength and show its relevance to professions, **information** sharing is key for both researchers as well as professionals. At OR-AS, we strongly believe that the translation of the often highly advanced writings in easy-to-read and accessible articles is a way to push the research findings from an academic environment to the business world.

The dispersion and promotion of our research is done via various channels, such as business articles [e.g. the Measurable News], an online PM Knowledge Center, a yearly EVM Europe conference and much more that can be read in other pages of this book.



In order to apply the newly developed techniques in a business context, the models have to step out of the academic environment, and must be **supported** by software tools, business trainings and consultancy projects. The OR-AS IT approach is therefore considered as an interface between the research and the outside world.



The newly developed software and the underlying algorithms must be embedded in the current IT processes of the company. A strong focus on **integration** in terms of flexibility and open exchange of data is key to the success of our IT implementations. P2 Engine as an open and flexible tool that can be integrated in any IT system, from a simple MS Excel file to a more advanced ERP system.



**Feedback** is key to the success of our products and is embedded in the heart of the OR-AS development approach. It stimulates the creation of new research ideas, it leads to improvements in the current products and it brings researchers closer to PM professionals.



“If you've got an idea, start today.  
There's no better time than now to get going” (Kevin Systrom)

## The app (2013 - 2016)

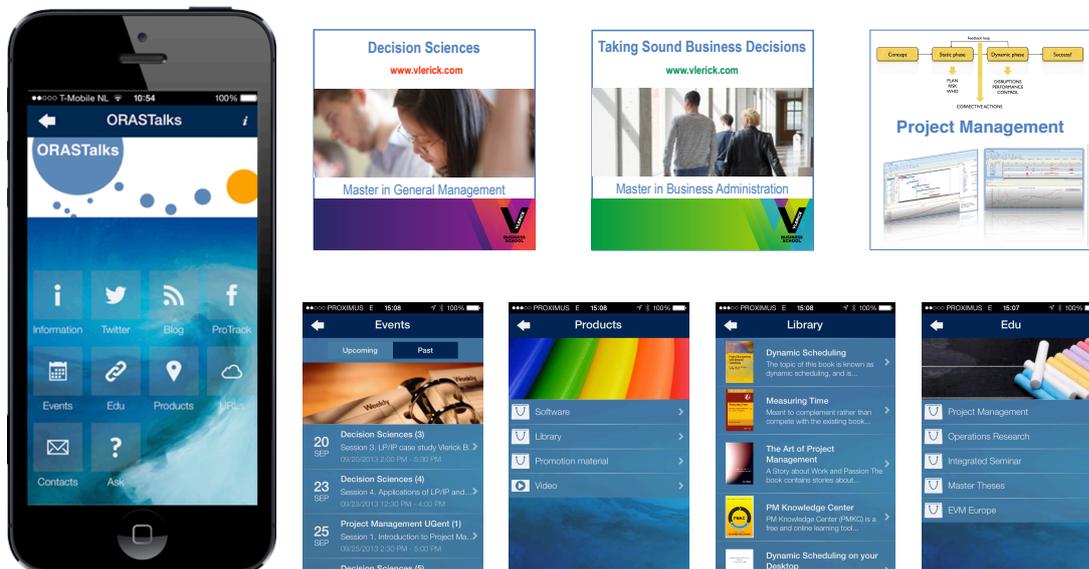
ORASTalks was an app that aimed at bringing students together to offer them a central place for their course content, to provide them with additional background information and to bring them in contact with interested professionals.

OR-AS is an acronym for "**Operations Research - Applications and Solutions**" and develops software Applications and Solutions for academia and business based on a well-balanced combination between academic knowledge and practical experience. It serves as a bridge between the academic environment of our university and MBA students and the business world that they will soon (re-)discover after their graduation.

The specific approach to improve and optimise business processes consists of data analysis, simulation and optimisation using state-of-the-art tools and techniques, followed by the implementation and validation. The field of Operations Research is applicable to many complex business processes.

Special attention is devoted to **Integrated Project Management and Control** using well-known as well as novel project management tools and techniques.

OR-ASTalks has been launched in 2013, and after almost 1,000 downloads, it has been decided to no longer support further updated. It was a joyful experience.



## Who

ORASTalks was developed by OR-AS for students and professionals who share a common passion in Project Management and Operations Research, interested in how complex business processes and projects should be monitored, and how to get them, in case of problems, back in control. It is aimed at getting students involved in the work done by their fellow students, and in the work done by the many professionals working together with us. It also aims at bringing these professionals closer to the students and researchers such that they can share their knowledge and exploit opportunities.

Download Now



## Back to 2013: How to download... and share

Are you a student at **Ghent University** following a Project Management or Operations Research course, or an Erasmus student visiting our Faculty of Economics and Business Administration, or maybe an MBA student at **Vlerick Business School** in Ghent, Brussels, Leuven, St-Petersburg or Beijing, or a student at the department of Management Science and Innovation of **University College London**?

... Then this app is made for you!

Or are you a Project Management professional, possibly a member of the **Project Management Institute** (Belgium chapter) or the **International Project Management Association**. Are you active in Belgium or working abroad? Are you a potential participant of **EVM Europe**? ([www.evm-europe.eu](http://www.evm-europe.eu))

... Then this app might be useful to you!

Since **ORASTalks** wants to connect the Project Management and Operations Research students with the consultants and professionals to share their experience and interact. Download the ORASTalks app from the Apple App Store, the Google Play Store or the Windows Phone Store and see what happens inside, in the academic world, and outside, in the professional world.



**1. Social interaction.** See what happens, interact and share using the Facebook account made by students or via the ORASTalks Twitter and Blog accounts.

**2. Event calendar.** Consult your teaching schedule, discover the schedule of your colleagues and get to know how the EVM Europe conference can be beneficial to you.

**3. Edu page.** Learn more about the course outlines and workshops and explore the course objectives and learning outcomes of your and your colleagues' curriculum.

**4. Products.** Get acquainted with the software tools used in class, visit the Project Management bookstore, read about the teacher and students awards and make use of our online learning platform PM Knowledge Center.

## 2016: Goodbye to our app

At end of 2016, ORASTalks will no longer be available as an app. Our followers can join the [ORASTalks facebook group](#), and follow our blog and other related activities via our [OR-AS website](#).

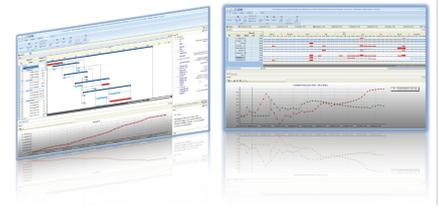


**ORASTalks**  
Education

Welcome to the Facebook page for students and professionals with an interest in Project Management. This page replaces the ORASTalks app that has been removed from the app store in 2016. For more information on our research activities, visit the OR-AS website at [www.or-as.be](http://www.or-as.be).

# ProTrack 3.0

## Dynamic scheduling on your desktop



“ProTrack is used in all our trainings on project management and control. Thanks to its full integration with PM Knowledge Center, it allows better learning in managing and controlling projects”

### The software

ProTrack 3.0 is a complete redesigned version of the smart version of ProTrack 2.0. Its integration with PM Knowledge Center and its strong focus on the integration of baseline scheduling, risk analysis and project control makes it yet a stronger learning tool to stimulate interaction between researchers, students and practitioners in the field of project management and dynamic scheduling.

### Used by academics and professionals

ProTrack is useful for constructing baseline schedules, risk analyses and control reports for complex projects with limited resource availabilities, and restricted time and budget constraints. The integration between these three project management disciplines is known as dynamic scheduling and has a central focus in all the activities of OR-AS.

**Focus.** ProTrack puts a strong focus on the integration between the three dynamic scheduling dimensions:

- Baseline Scheduling: Critical path and resource scheduling
- Risk Analysis: Schedule risk analysis and Monte-Carlo simulations
- Project Control: Earned Value Management and Earned Schedule control

**Release.** The third release of ProTrack contains a new online support and help center and is now used in both academic and business trainings.

**Research.** ProTrack’s algorithms are based on award winning research published in two international books and a free online learning tool PM Knowledge Center.

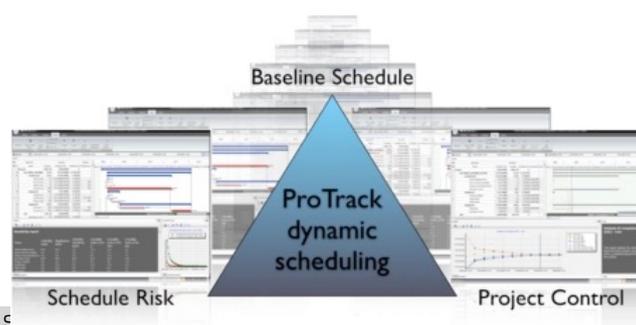
PM Knowledge Center [[www.pmknowledgecenter.com](http://www.pmknowledgecenter.com)] brings relevant articles and references on dynamic scheduling together at one place! ProTrack’s help and support center allows the user to interact with the OR-AS team for useful suggestions and comments, to report problems and to propose and share future development ideas.

### Who

ProTrack is developed by and for professionals who share a common passion to get complex projects in progress back in control. It is relevant to project managers working in both the private and public sector, and applies to large and small projects with critical performance, time and budget targets.

### Pricing

A ProTrack license costs € 299 and includes a full integration with PM Knowledge Center. Free academic licenses and demo versions with limited functionality are available upon request.





**Buy Now**

## How to order...

... and use it as a professional, trainer, student or lecturer

Are you a lecturer, student or PhD researcher in Project Management, or a project management professional and do you want a fully functional ProTrack 3.0 version? Simply follow this four-step procedure and ProTrack 3.0 is ready for you and your professional life:

**Step 1.** Order a ProTrack license using the OR-AS online order form on [www.or-as.be/order](http://www.or-as.be/order).

**Step 2.** You receive a user name and login to access your personal support page.

**Step 3.** Download ProTrack 3.0 from your personal support page and install it on one computer.

**Step 4.** Upon installation, you have to input a serial number and request a release code to unlock the license. When you are online, this serial number will be automatically sent to you to unlock the installed version.

## You receive...

**1.** ProTrack 3.0: The advanced stand-alone dynamic scheduling software tool integrating baseline scheduling, risk analysis and project control that runs on Windows.

**2.** Online integration with PM Knowledge Center: The automatic integration with PM Knowledge Center and an automatic free login to member areas using your personal ProTrack login user name and password.

**3.** Support: Automatic online access to a personal support page by one simple click to communicate with the OR-AS support center.

**4.** Example project files with extra project information in pdf sheets.

## How to access PM Knowledge Center

PM Knowledge Center is accessible via any web browser ([www.pmknowledgecenter.com](http://www.pmknowledgecenter.com)) and is also integrated in the welcome screen of ProTrack 3.0. Automatic update checks are available upon using ProTrack and access to a personal support and comment page can be done by one single click.

## Not convinced? Try first!

A free demo version of ProTrack 3.0 can be requested: It has a restricted functionality and expires after one month. Free fully functional academic ProTrack versions can be used by students when the course owner has bought a valid ProTrack license as described above. The free student academic licenses are valid for one year and can be renewed.

## More information

For more information on ProTrack or the ordering process, go to [www.protrack.be](http://www.protrack.be), contact us at [info@or-as.be](mailto:info@or-as.be) or read about the ProTrack functionality in “Measuring Time” and “Dynamic Scheduling” published by Springer.

# The Project Scheduling Game

## Project Management skills that you will never forget!



“The Project Scheduling game may easily be integrated into existing training programs. Each game session usually takes a full day in a classroom with participants working in groups of 2 to 4 people”

### The simulation game

The Project Scheduling Game (PSG) is an IT-supported simulation game to train young project management professionals the basic concepts of baseline scheduling, risk management and project control.

The Project Scheduling Game consists of two modules:

- The PSG Simulator module: A graphical user interface for the participant to play the game
- The PSG Creator module: A full version used by the educator to create game projects or change the game settings

### Education approach

The PSG involves a time/cost trade-off in project activities and requires the construction of a project baseline schedule within a restricted time and limited budget. The uncertainty during project progress disturbs the original baseline schedule and requires interventions to bring the project back on track. The game is a learning tool that can be integrated in any Project Management course, and can be used in undergraduate programs, MBA courses or commercial trainings.

**Introduction.** A 1 to 3-hours introduction on project scheduling techniques and the critical path method is followed by a 90 minutes game session.

**Game.** A 90 to 120-minutes game session where the participants have to analyze the current project performance, analyze alternatives and finally take decisions at each decision moment.

**Feedback.** A 1 to 2-hours feedback session to measure the performance of the students and to set up a game discussion to describe the ideal strategies to copy with project complexity and uncertainty.

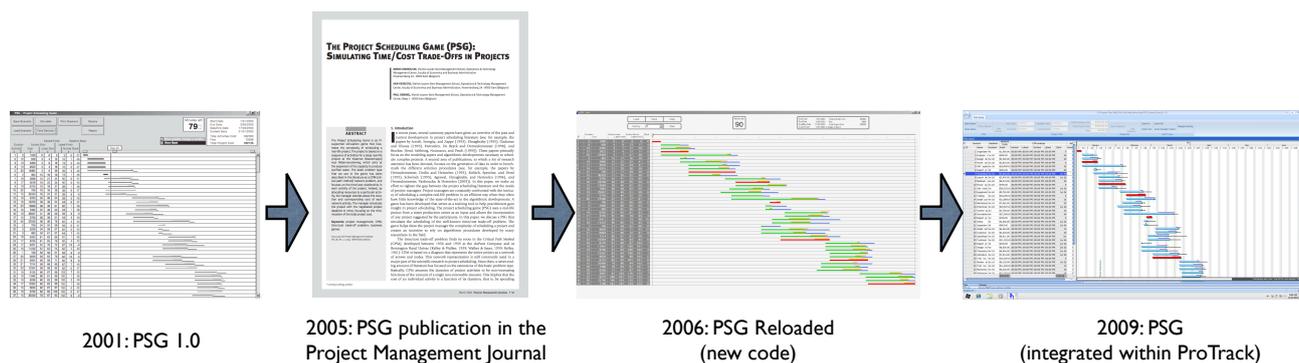
Each teaching session can be supported by articles from the online learning tool [www.pmknowledgecenter.com](http://www.pmknowledgecenter.com).

### Who

PSG has been extensively tested in the classroom by undergraduate students at Ghent University (Belgium) and University College London (UK), by MBA students at Vlerick Business School (Belgium), Antwerp Management School (Belgium) and EDHEC Business School (France), and in various commercial trainings.

### Pricing

An **academic** PSG Suite license costs € 599 and includes one Teacher edition and an infinite amount of Student editions. A license is valid for a single training day, and can be renewed at a reduced price of € 399 per course. The **business** PSG Suite license costs € 599 per bundle of 4 participants up to 20 participants. Extra participants (> 20) are charged at € 75 per person.



**Buy Now**

## How to order...

### ... and distribute among your students

Are you a lecturer in Project Management and do you want to order a Project Scheduling Game (PSG) Suite for use in your course? Simply follow this six-step procedure and PSG is ready for you and your students:

**Step 1.** Order a PSG Suite license using the OR-AS online order form on [www.or-as.be/order](http://www.or-as.be/order).

**Step 2.** You receive a user name and login to access your personal support page.

**Step 3.** The PSG Teacher edition can be downloaded from the personal support page and installed on your computer.

**Step 4.** You can register a course by adding course information (number of students, course date) to request a master serial key for the PSG Student editions to be used by your students.

**Step 5.** An email will be sent to you for the requested course containing a web link and a master serial key that you can forward to your students.

**Step 6.** Students can now download the PSG Student edition and install the game by entering the master serial key and a valid email address. They will automatically receive a release code to unlock the installed version. This PSG Student edition holds for only one Project Management course and expires after two months.

## You receive...

1. A single PSG Teacher edition for personal use, including a Simulator and a Creator module. The PSG Teacher edition can be downloaded from your personal support page and has no expiring date.

2. As many PSG Student editions as you wish, including a Simulator module to distribute among your students. The PSG Student edition can be downloaded by all your students from a webpage and expires two months after installation.

3. A pdf file with information of the projects of PSG to distribute among your students.

4. An MS Excel feedback solution file to benchmark your students' results during your feedback session.

## How to distribute among your students

You will automatically receive an email (step 5) with a download link for the PSG Simulator module for your students. You just have to forward this email a few days in advance to your students and they will be able to download and play the game (step 6) at the day of your teaching session. Two months after your session, their Simulator module will expire.

## Another course

When you want to use the PSG for another course with another group of students, you don't need to follow the six step procedure again. You simply register as a trainer for a new course on your support page (step 4) and your new students will receive an email and download link.

## More information

For more information on the game or the ordering process, go to [www.or-as.be/psg](http://www.or-as.be/psg), contact us at [info@or-as.be](mailto:info@or-as.be) or read the PSG article in the Project Management Journal, 51, 51-59, 2005.

# PSG Extended

## Effort driven decision making



“Quality is never an accident. It is always the result of intelligent effort” (John Ruskin)

PSG Extended is a PM game that is an extension of the Project Scheduling Game (PSG). While PSG focuses on the dynamic progress of projects and the time/cost decision that must be made to deliver the project on time at the lowest possible cost, PSG Extended focuses on the underlying solution approach/mechanism taken by participants who have successfully played the Project Scheduling Game.

Both PSG and PSG Extended have a triple focus, i.e. learn how to cope with **risk**, while optimizing the **time** and **cost** of the project in progress.

**Risk.** The inherent uncertainty of projects in progress causes activity delays as well as activities that end ahead of schedule

**Time.** The deadline of the project is stipulated by the client, and the penalty is set to give the contractor the incentive to focus on this deadline

**Cost.** The ultimate goal is to minimize the total cost of the project, including activity costs as well as possible penalties for deadline violations

The actions taken by the participants involve a decrease in activity duration at a certain predefined cost, which is known as “activity crashing”.

### Decisions

The activity crashing decisions are made during periodic decision moments where a project in progress must be brought back to plan when problems occur. Deciding how to optimally exploit the possibility to change the durations and costs of each activity involves a certain underlying solution approach and methodology which must be defined by the participant. While PSG primarily focuses on the dynamic nature of projects in progress, PSG Extended puts a clear focus on this solution mechanism, which consists of the following elements:

- **Schedule focus:** When decisions must be taken during multiple time periods, a choice between a local or global focus determines the time horizon of the decision approach, and hence, the impact of decisions on the future progress of the project
- **Activity ranking:** Setting priorities on activities depends on the time/cost options and their impact on the total duration and cost of the project
- **Time/cost focus:** The time/cost focus of the game lies in the heart of PSG and is therefore also the most important decision that can be made in PSG Extended
- **Deadline focus:** Meeting the deadline depends on the size of the penalty stipulated by the client and the marginal cost of activities to crash
- **Slack consumption:** A sound and detailed network analysis to discover areas for cost improvements involves a study to the activity slack in the schedule, which periodically changes along the progress of the project
- **Cost/benefit analysis:** Determining whether a change is beneficial involves a comparison between the cost of crashing and the impact and benefit it has on the total project duration and penalty cost

**Buy Now**



**Effort**

Making decisions using the building blocks involves a certain trade-off between a continuous detailed follow-up of every aspect of the project, leading to a time-consuming and cumbersome task, or rather a global helicopter view on the overall project progress, focusing only on the general aspects of the project without spending much time and effort in the details. Hence, every decision involves a certain degree of effort one wants to put during each decision moment, which eventually defines a footprint of the total effort spent on monitoring and controlling the project control.

Every parameter that can be set for the building blocks of the decision has a certain predefined effort, and the total effort to monitor the project is limited to a certain maximum value. Participants of PSG Extended have therefore set the parameters of each decision for each decision moment such that they do not exceed the total allowable effort. This effort driven decision making process constitutes the heart of the methodology of PSG Extended.

**Who**

While PSG is accessible for any participant, with or without a background and experience in Project Management, PSG Extended is not for dummies. Instead, it is used for experienced Project Managers, or Computer Scientists with an interest in management, or anyone else who has knowledge and interest in network analysis, priority-rule based scheduling, and who are eager to learn to discover the secrets of optimization and solution approaches behind PSG. In my experience, a minority of around 1/5th of the PSG participants want to learn more about the underlying mechanisms and algorithms to solve PSG. This game is for them! Welcome to the secrets of project time/cost optimization and the underlying algorithms of PM software tools.

**The Project Scheduling Game**  
Powered by OR-AS ([www.or-as.be](http://www.or-as.be))  
 Visit [www.pmknowledgecenter.com](http://www.pmknowledgecenter.com) and read the article "The Project Scheduling Game (PSG): Time/cost trade-offs on a computer screen"

		1	2	3	4	5	6
<b>Name</b>		ENTER NAMES IN THIS CELL!					
<b>Decision Moment</b>							
<b>Schedule Focus</b>		1	1	1	1	1	1
<b>Activity Focus</b>							
<b>Activity Ranking</b>							
Critical Activities		LPT	MinCrit	MinCrit	MinCrit	MinCrit	MinCrit
Non-critical Activities		MinSlack	MinSlack	MinSlack	MinSlack	MinSlack	MinSlack
<b>Time/cost Focus</b>							
Critical Activities		0.25	0.25	0.25	0.25	0.25	0.25
Non-critical Activities		0.25	0.25	0.25	0.25	0.25	0.25
<b>Action Radius</b>							
<b>Deadline Focus</b>		Low	Low	Low	Low	Low	Low
<b>Slack Consumption</b>		Low	Low	Low	Low	Low	Low
<b>Cost/Benefit Analysis</b>							
Critical Activities		100%	100%	100%	100%	100%	100%
Non-critical Activities		100%	100%	100%	110%	100%	100%
<b>Effort Loading</b>		Low	Low	Low	Low	Low	Low
<b>Total Effort Consumption:</b>		60.56%					

**Comment:**  
 This is a good start solution.  
 However, you have still room to increase the total effort (max. 100%).

The PSG Extended GUI  
[\[www.or-as.be/psg\]](http://www.or-as.be/psg)

# PM Knowledge Center

Step inside - Knowledge freely available!



"Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it" (Samuel Johnson)

## PM Knowledge Center

PM Knowledge Center (PMKC) is a free and online learning tool to stimulate interaction between researchers, students and practitioners in the field of project management. It contains articles and reference resources to inform and improve the practice of dynamic scheduling and integrated project control.

PMKC contains different modules that can be used in classroom trainings:

- Preface articles with links to classroom training opportunities
- Knowledge articles on baseline scheduling, risk analysis and project control
- Press publications related to events from our partners

## Online learning

The PMKC online learning tool offers students and trainers insights and information on important topics on dynamic scheduling, and its content can be used at undergraduate courses, MBA programs and commercial PM trainings to support better results of learning. PM Knowledge Center brings relevant articles and references together at one place!

**Articles.** Get involved by reading our knowledge articles, test your knowledge using our Q&A exercises and step outside your environment and read the press publications on all our PM activities.

**Integration.** PM Knowledge Center is fully integrated with the commercial software tool ProTrack and the IT-supported Project Scheduling Game (PSG).

**Research.** The knowledge shelf of PMKC is based on the research handbooks "Measuring Time", "Dynamic Scheduling" and "Integrated Project Management & Control" awarded by IPMA and published by Springer.

## Dynamic Scheduling

Dynamic scheduling is a term used to refer to the integration between baseline scheduling, risk analysis and project control. This dynamic scheduling point-of-view implicitly recognizes that a project baseline schedule only acts as a point-of-reference in the project life cycle for risk calculations and project control. It illustrates that a project schedule should be considered as nothing more than an ever changing predictive model that can be used for resource efficiency calculations, time and cost risk analyses, project control and performance measurement.

**Welcome to PM Knowledge Center!**

PM Knowledge Center (PMKC) is an online learning tool on Project Management and Dynamic Scheduling and includes technical articles on "project baseline scheduling", "schedule risk management" and "project control" as well as quizzes to test your knowledge on these topics. PMKC is fully integrated in ProTrack 3.0, and all our users can automatically find all updates there. Visitors of PMKC can browse all free content or use the search engine on the right top of this page. Most articles at PMKC are short and to-the-point, and more detailed and technical information can be found by clicking on the following logos.

Project Management with Dynamic Scheduling  
european association of project management (EAPM) 5.0  
ProTrack 3.0  
Measuring Time  
Integrated Project Management and Control  
Integrated PM&C

**Preface** | Baseline Scheduling | Risk Analysis | Project Control | Press

- Dynamic scheduling: Welcome to PM Knowledge Center
- Message to teachers: Integrate PMKC in your PM course
- Message to students: Interested in Project Management? Get Involved!

Join Now



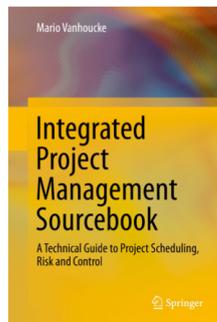
## How to join PMKC...

... and browse, interact and test your Project Management knowledge

Are you a lecturer, a student, a researcher or a professional in Project Management? Or are you completely new in Project Management but interested and eager to know more? Join us at PM Knowledge Center, browse, read and interact.

All the content is freely accessible at PMKC. Articles can be downloaded by one single click. Since 2016, the Q&A exercises have been removed from the website and have been assembled in the book **"Integrated Project Management Sourcebook: A Technical Guide to Project Scheduling, Risk and Control"**.

### PM Knowledge Center is now available as a book!



#### New Project Management Sourcebook

- + 70 articles
- + 300 example questions (and answers)
- + Links between articles
- + MS Excel file with solutions



Visit the bookstore

All articles of PM Knowledge Center are now assembled in a sourcebook, containing +70 articles and + 300 Q&A exercises  
([www.or-as.be/books/pmkc](http://www.or-as.be/books/pmkc))

## Articles

All articles can be freely downloaded from the internet, or will be automatically downloaded in your ProTrack 3.0 welcome screen. The set of articles is bundled in five classes:

**Preface.** Get involved by reading our knowledge articles, test your knowledge using our quizzes and step outside your environment and read the press publications on all our PM activities. Welcome to PM Knowledge Center!

**Baseline Scheduling.** Read our articles on network analysis, resource analysis and scheduling techniques based on years of research at the Project Management research group at Ghent University (Belgium)

**Risk Analysis.** Get acquainted with analyzing risk of a project baseline schedule using a Schedule Risk Analysis (SRA) or the well-known Critical Chain/Buffer Management (CC/BM) approach

**Project control.** Learn to better monitor and control your projects using Earned Value Management (EVM) systems, including the novel Earned Schedule (ES) method as well as various other schedule control approaches

**Press.** Learn how we interact and collaborate with PMI Belgium, EVM Europe and the College of Performance Management

## Interact

PM Knowledge Center can only grow and improve with your feedback. Comment on an article, ask a question or share your opinion with us. Our mission? Never stop learning!

# P2 Engine

Advancing the state-of-the-art knowledge



“Progress lies not in enhancing what is, but in advancing towards what will be”  
(Khalil Gibran)

## P2 Engine

P2 Engine is a command line utility tool based on the LUA scripting language to generate gigabytes of project data. It generates project baseline scheduling data and risk analysis metrics as well as dynamic project progress data that can be used for testing and validating novel research ideas.

The algorithms of P2 Engine can be classified into three classes:

- Baseline Scheduling: Schedule projects using critical path and resource allocation algorithms
- Risk Analysis: Analyze project risk using basic or advanced Monte-Carlo simulation runs
- Project Control: Generate project performance data and analyze Earned Value Management control data

## Faster than ever before

P2 Engine gives the user access to a wide range of complex algorithms incorporated in ProTrack 3.0. By using simple scripts, any researcher can solve difficult and critical dynamic project scheduling optimization problems using these intelligent algorithms. P2 Engine can easily produce an enormous database of optimization results for a wide range of project management problems faster than ever before and advances the state-of-the-art knowledge available today.

**Platform.** P2 Engine is a platform independent software tool that runs on Windows, Mac as well as on Linux.

**Power.** P2 Engine runs on the supercomputer of the Flemish Supercomputer Centre (VSC). This cluster of computers is the largest academic computing infrastructure in Flanders.

**Research.** P2 Engine is used for a more than a million euro research project at Ghent University (Belgium) in collaboration with University College London (UK) and George Washington University (US).

P2 Engine is based on the LUA scripting language available at [www.lua.org](http://www.lua.org).

## Who

P2 Engine is currently used as a research tool for master students and PhD students at Ghent University (Belgium), and for consultancy projects to advance current business processes with extended dynamic scheduling features.

## Pricing

Free academic licenses are available upon request. Commercial business licenses are used for integrating P2 Engine in existing software business systems or to analyze your projects through a detailed project scan.





“If you can't measure it, you can't manage it”

How to scan your project...

... and analyze, understand and improve your project characteristics

Through a well-balanced combination between research experience and practical relevance, OR-AS measures and maps your project characteristics and analyzes its strengths and weaknesses in order to improve your integrated project control approach at your company. A project scan is relevant for project managers working in both the private and public sector, and applies to large and small projects with critical performance, time and budget targets.

Project scan

The central idea of a project scan is to understand the underlying characteristics and to map them with the best practices and research knowledge to better control your projects and improve your actions to bring projects in danger back on track. It is based on an award winning methodology published in “Measuring Time” and benchmarks your project along the four following dimensions:

**Network scan.** The characteristics of your project WBS in terms of network topology and time and cost distributions is a crucial factor in the understanding and selection of the best project control method.

**Resource scan.** The efficiency of your resource allocations depends on the availability and tightness of your resources and has an impact on the schedule risk analyses and project control methods.

**Sensitivity scan.** A Schedule Risk Analysis (SRA) using basic and/or advanced Monte-Carlo simulation runs is a crucial analysis to validate the efficiency of a bottom-up control approach for your project.

**Control scan.** A project control scan using simulated time/cost accuracy predictions is a necessary prerequisite for understanding the efficiency of a top-down control approach using Earned Value Management/Earned Schedule (EVM/ES) performance systems.

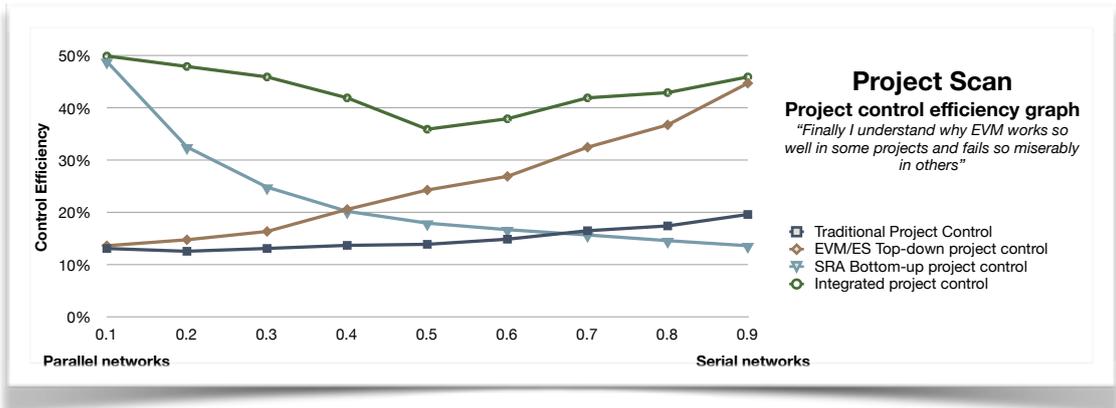
Methodology

A project scan is done by P2 Engine which is the fastest and most efficient Project Management monitoring tool developed at Ghent University (Belgium) and commercialized by OR-AS. P2 Engine is based on the LUA scripting language (www.lua.org) and makes use of the efficient algorithms of ProTrack (www.protrack.be).

Pricing

The price of a project scan depends on the size of your project and the quality of the delivered data, and includes an analysis in P2 Engine and a written evaluation report. The data should be delivered as an MS Excel data dump from your company's PM software tool or as a ProTrack file. Extra costs can be incurred when data is not available or when extra interfaces must be written to import/export your data into an easy-to-access database format. A further integration between P2 Engine and your software processes belongs to the possibilities upon evaluation of the project scan results and is not included in the project scan proposal.

<Download this project scan methodology in the keynote presentation of EVM World 2012 from www.or-as.be>





“If you want to teach people a new way of thinking, don't bother trying to teach them. Instead, give them a tool, the use of which will lead to new ways of thinking” (Richard Buckminster Fuller)

### Spreadsheet

While PM software tools such as MS Project, Primavera or - my favourite - ProTrack allow the user to analyze projects in detail, these tools often have a steep learning curve. Some of my university and business school students are totally new in the PM area, and do not need an advanced tool to start. Rather, they need to see how the principles of my lectures are used and calculated on simple and small projects. MS Excel is therefore the ideal tool. No learning curve, just the good old spreadsheet that everybody knows.

ProXL is an acronym for **PRO**ject management in **eXceL**. It is an easy to use tool for small projects, and has no intention to replace the existing tools. Instead, it can be used to take a look on how projects are planned, analyzed and controlled. Nothing more, nothing less. It's a tool to translate the principles of my lectures into a visual and practical application.

ProXL is a dynamic tool that contains four main tabs, as follows:

**Baseline scheduling:** ProXL automatically determines start and finish times of each project activity within the activity network constraints which results in an expected timing of the work to be done as well as an expected impact on the project's time and budget implications. ProXL makes use of an activity-on-the-node network and the precedence relations are restricted to finish-to-start (FS) relations with a minimal time-lag of zero. The algorithm used is the standard critical path method, and no resource scheduling is implemented.

**Schedule Risk Analysis:** ProXL implemented this methodology to assess the risk of the baseline schedule and to forecast the impact to time and budget deviations on the project objectives based on distributions on the activity durations. It makes use of distributions on activity durations and assumes that the cost is linearly distributed over time (shorter duration = lower cost; longer duration = higher cost). The cruciality index (CRU) used in ProXL for time and cost is the Pearson's product-moment correlation. Further reading is recommended for advanced users using the references of the OR-AS bookstore.

**Project control:** ProXL is a tool to monitor deviations from the expected project progress and to control its performance in order to facilitate the decision making process in case corrective actions are needed to bring projects back on track. Both traditional Earned Value Management (EVM) and the novel Earned Schedule (ES) methods are used. It makes use of a monitoring and control system on the work package level (and not on the activity level). Further reading is recommended for advanced users using the references of the OR-AS bookstore.

**Dashboard:** The dashboard of ProXL displays the baseline schedule with activity names and work packages and the Planned Value curve. The dashboard can be used for both bottom-up and top-down control. The bottom-up control pane displays the sensitivity metrics (CI, SI, SSI, CRU(t) and CRU(€)) and the action threshold graph, while the top-down control shows summary statistics (key, performance and forecasting metrics) and summary graphs for facilitating actions to bring the project back on track.

### Tutorials

ProXL is very intuitive and easy to use (given that the user has knowledge of planning, risk and control). It contains only four tabs, as discussed before. ProXL is accompanied by four tutorials for the four MS Excel tabs, which can be downloaded from [www.or-as.be/proxl](http://www.or-as.be/proxl).

- Baseline scheduling (ProXL\_BS)
- Risk analysis (ProXL\_RA)
- Project control (ProXL\_PC)

- Dashboard (ProXL\_DB)



## Use

ProXL is currently used for three course modules. At Vlerick Business School (Belgium), ProXL is the foundation for a series of four integrated case studies for the “International Project Management” and “Data-driven Project Management” course modules. At UCL School of Management (UK), ProXL is used for exercises and case studies for the “Project Management” course module.

These case studies consist of several integrative and sequential exercises, aiming at learning to understand and use the basic principles of PERT, CPM, SRA, CC/BM, EVM and ESM (I realize that this sentence is full of abbreviations, so I have written their full meaning below). These case studies have been used as the foundation for the book “On the Right Track”. In this book, I have used ProXL for taking screenshots and for performing the numerous calculations. All the data used in the book is available in a ProXL format, and is free for download.

**ProXL: Integrated Project Management and Control**  
The tool for project baseline scheduling, schedule risk analysis and project control  
 Written by Mario Vanhoucke (www.or-as.be)

**INFORMATION**  
 ProXL is an MS Excel tool for integrated project management and control based on **ProTrack** and **P2 Engine**, and includes:

- **Schedule:** Construct an Earliest Start Schedule (ESS) and save it as your baseline schedule
- **Risk:** Perform a Schedule Risk Analysis (SRA) using distributions on your activity durations
- **Control:** Monitor the performance of your project on a periodic basis using Earned Value Management (EVM)
- **Dashboard:** Select a period and look at your project performance using the top-down and bottom-up project control dashboards

**READ THIS FIRST**

**HOW?** See how the sheets must be used in the “how?” description  
 More info on the use can be found at [www.or-as.be/proxl](http://www.or-as.be/proxl)

**Save** Changes are only incorporated after saving (calculations might be time consuming!)  
**Tip:** Do not use copy-paste and put automatic calculations off!

**!** Possible input errors are displayed as red or green icons to the left of each sheet  
 More information of errors are given in the error pane

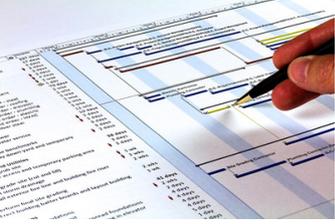
**X** ProXL works in MS Excel 2011 for Mac, 2013 for Windows xxxxxx  
 ProXL has some known issues in MS Excel 2007 on Windows 7 and its use is not recommended

**STOP READ THIS** Download short and easy to read tutorials  
 (3 page tutorials available for each sheet)

**PM** Visit the relevant articles at PM Knowledge Center  
 Visit: [www.pmknowledgecenter.com](http://www.pmknowledgecenter.com)

**Feedback** Comments and suggestions for improvements are welcome  
 mail to: [mario.vanhoucke@ugent.be](mailto:mario.vanhoucke@ugent.be)

**NEW VERSION** Version 2.0, May 2016  
 Check for updates: [www.or-as.be/proxl](http://www.or-as.be/proxl)



ProXL, Version 2.0.0, © 2015, OR-AS. All Rights Reserved. License Agreement.

Automatic Calculations On      Automatic Calculations Off

Every manual input requires continuous calculation in ProXL.  
 This might consume time and cause huge waiting times.  
 Automatic Calculations can be turned:  
 - On: Input changes have an immediate effect (after all calculations are done) (not recommended)  
 - Off: Input changes have only an effect after saving (default)

**BOOKSTORE**  
 Many of the ProXL features are based on sound academic research and professional experience as described in the following books:  
[www.or-as.be/books](http://www.or-as.be/books)

**Springer books**  
(click on picture for more information)

-  **Project management knowledge sourcebook: The technical guide to project scheduling, risk and control**  
 Mario Vanhoucke  
 2016 (1st edition), Springer: 294 pages
-  **Integrated project management and control: First comes the theory, then the practice**  
 Mario Vanhoucke  
 2014 (1st edition), Springer: 141 pages
-  **Project management with dynamic scheduling: Baseline scheduling, risk analysis and project control**  
 Mario Vanhoucke  
 2013 (2nd edition), Springer: 318 pages
-  **Measuring time: Improving project performance using earned value management**  
 Mario Vanhoucke  
 2010 (1st edition), Springer: 164 pages

**OR-AS books**  
(click on picture for free download)

-  **The art of project management: A story about work and passion**  
 Mario Vanhoucke  
 2015 (3rd edition), OR-AS: 93 pages
-  **Taking sound business decisions: From rich data to better solutions**  
 Mario Vanhoucke  
 2015 (1st edition), OR-AS: 80 pages
-  **Dynamic scheduling on your desktop**  
 Mario Vanhoucke and Tom Van Acker  
 2010 (1st edition), OR-AS: 63 pages

The start screen of ProXL with links to the bookstore, tutorials, PM Knowledge Center, and of course, the 4 tabs of ProXL

## Abbreviations:

- PERT: Programme Evaluation and Review Technique
- CPM: Critical Path Method
- SRA: Schedule Risk Analysis
- CC/BM: Critical Chain/Buffer Management
- EVM: Earned Value Management
- ESM: Earned Schedule Management



# Project Portfolio Database

## Artificial and empirical projects

“Without data you're just another person with an opinion.” - Edwards Deming

### Artificial or empirical data

When I was still a young PhD student, I started a study on project data which is - 25 years later - still ongoing.

**Artificial** project data are generated under a controlled design, and used by researchers to construct resource-feasible schedules. The data consist of a project network with activities, precedence relations, and renewable resources. The data can be generated in a very diverse way, but since the projects are not real, no project progress data are available.

**Empirical** project data are not generated, but instead, collected from companies. The data are therefore richer and more realistic, but also prone to errors and biased inputs. The use of the empirical data goes beyond the construction of schedules, but can also be used for research on risk analysis and project control.

### Problems

The academic literature on project scheduling loves acronyms for defining the scheduling problems. The most well-known problem is the so-called **resource-constrained project scheduling problem** (RCPSP) which forms the foundation of most scheduling research. Despite the complexity of the problem, more advanced and more realistic versions have also been defined such as:

- The multi-mode RCPSP (MRCPSP) assumes that activities can be executed in different ways (modes).
- The RCPSP with alternative subgraphs (RCPSP-AS) adds flexibility in the project network.
- The RCPSP with people skills is known as the multi-skilled RCPSP (MSRCPSP).
- The extension to portfolio planning is referred to as the resource-constrained multi-project scheduling problem (RCMPSP).

Our databases contain project data for all these challenging problem types.

### Databases

#### Artificial data

The artificial project databases consist of the following data libraries:

Library 1. Resource-constrained project instances: 9 sets with +3 million projects

→ This library consists of different sub-libraries with project data for four types of resource-constrained project scheduling problems:

- Different sets for the RCPSP
- Three sets for the MRCPSP
- Two sets for the RCPSP-AS
- A new set for the MSRCPSP

Library 2. Hard project instances: A new CV set of 623 projects (CV is an abbreviation for “Coelho and Vanhoucke”)

→ Download our project dataset of 623 small but difficult instances that are currently impossible to solve to optimality with the current state-of-the-art scheduling algorithms.

Library 3. Project portfolio data: 2 project libraries with  $\pm 40,000$  portfolios

→ Download project portfolio data for the multi-project resource-constrained project scheduling problem

#### Empirical data

Library 4. +150 projects from different sectors

→ Download our real project data for project planning, schedule risk analysis and project control.

### Data analysis

The overwhelming amount of project data should enable researchers to develop better algorithms for scheduling projects. However, it is not always easy to know whether the solutions are competitive with the existing solutions in the literature. In order to better analyse data and results from algorithms to construct schedules, a new tool and a new website is developed. The project data analysis tool “**SolutionsUpdate**” enables researchers to better compare results and validate the quality of algorithms. The project data and best known results can be downloaded and new improved results can be uploaded.

## Downloads

Much of the work done on project data is carried out together with my friend José Coelho from Lisbon (Portugal) [cf. other articles in this book]. Researchers with an interest in our data must visit the OR&S data webpage to find links to the data, the tool and much more:

[www.projectmanagement.ugent.be/research/data](http://www.projectmanagement.ugent.be/research/data)

The very first paper we have written about data generation dates back to 2003, and a first summary of the existing project data was published in a paper in 2016 (cf. picture below). Ever since, we have made a lot of progress on this exciting topic. A full overview can be downloaded as a summary brochure, with links to the datasets and the research published over the past decades.



The brochure is titled "PROJECT DATA" and is published by the "Operations Research and Scheduling Research Group". It features a navigation menu with five categories: Artificial Project Data, Empirical Project Data, Hard Project Data, Project Portfolio Data, and Project Data Analysis. Each category lists specific datasets and tools available for download. The main text discusses the "The resource-constrained project scheduling problem" and mentions researchers like Vanhoucke, Coelho, and Demeulemeester. It also includes a small portrait of a man and a quote: "Without data, you're just another person with an opinion." The footer contains the website "www.or-as.be" and "Page 1 of 7".

Download a summary brochure with details about the project data libraries from [www.or-as.be/downloads/projectdata](http://www.or-as.be/downloads/projectdata).



This video is recorded on July 26, 2016 in Lisbon with friend and colleague José Coelho. It gives a summary of our very first (but not the last) paper on project data. Given our progress in this topic, it is - luckily - no longer up to date. Watch the video at [https://youtu.be/QwyBs\\_TJMYo](https://youtu.be/QwyBs_TJMYo)

# Books



# Why I write books

**“If there's a book that you want to read, but it hasn't been written yet, then you must write it.” - Toni Morrison**

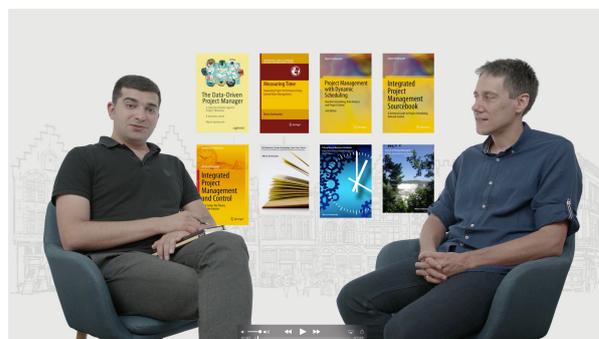
I was once asked by a university colleague why I spend time on writing books about a topic that is of interest to only a minority of the population, and why I keep pretending that there is a big audience out there. Why so much enthusiasm for something that will be hardly noticed in the outside world? Why? Oooh why?

I laughed out loud (LOL, you know) when I first heard this question, but the question fascinated me. Do I really know why?

While I have never pretended that there is a big audience out there, I write books as if there is one. Of course, I think that what I write is relevant, and I believe that there is an audience, but I have to admit: maybe not a big audience. Not like the Harry Potter books at least. But I write books to structure my ideas, to have supportive material for my lectures at the universities, business schools and companies where I teach. Reasons enough to write and keep writing. But most of all, I write books because I think I cannot find the specific content of my books in other books. I was very much inspired by the American author, and Nobel Prize winner (in Literature) Professor Toni Morrison, who once said:

“If there's a book that you want to read,  
but it hasn't been written yet,  
then you must write it.”

Writing is as simple as that. It is an act that you perform because you have or want to. It is living your life and feeling the need to tell a story. As a lecturer in project management and decision making, I believe telling a story is a big part of my job, so I write. Years ago, when I decided to write my first book, I doubted of course . . . Should I do it? I was not completely sure whether there would be an audience for such a book, I was feeling uncertain about the relevance of the topic, I was also not so sure whether it would make sense to spend so much time on it. But after some time, I



Interview with Nader Rad about my books  
(YouTube: <https://youtu.be/mDkR7r5J3Xc>)

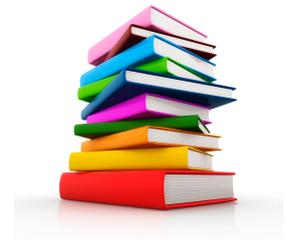
thought: “Aaah well, why not”, and I started writing. I like the act of writing, and it brought, and still brings, me at places I had never been before. So I will keep writing books, with or without an audience, with or without a publisher, as long as I keep enjoying the act of writing, and as long as it brings me at places I've never been. Just like the American novelist Roman Payne wrote in his book “The Wanderer”, writing books gives me the chance of being a wanderer.

“Just as a painter paints,  
and a ponderer ponders,  
a writer writes,  
and a wanderer wanders.”

So I have written some books and wandered around in the world. Some of the books contain technical details on data-driven project management, and serve as background material for my teaching sessions. Others are free to download and tell the story about the people and places I visited during my travels. Whatever the content or the intended audience, each book tells a different story, written at a different place, under different circumstances. But all of them have been a pleasure to write. Just like the wanderer enjoying different views along his/her walk, I had the pleasure to enjoy a mix of different experiences while writing my books. So let me briefly tell you my personal story behind the different books I wrote so far in the next pages of this book.

# Bookstore

Written communication with a targeted audience



“A mind needs books as a sword needs a whetstone, if it is to keep its edge” (George R.R. Martin)

## Bookstore

In the fast and ever-changing digital world, printed or online books on **Project Management (PM)** and **Decision Making** themes still serve as an important source for information and background material to advance knowledge. They can be and are used in commercial PM trainings, in university and business school programs as well as on academic and professional conferences.

The topics covered in the five books can be classified into three classes:

- **Baseline Scheduling:** Schedule projects using critical path and resource allocation algorithms
- **Risk Analysis:** Analyze project risk using basic or advanced Monte-Carlo simulation runs
- **Project Control:** Generate project performance data and analyze Earned Value Management control data

## Apress books

My first, and only, business novel about data-driven project management, published by Apress:

**The Data-Driven Project Manager.** Structured as a novel, this book provides real-time simulations of how project managers can solve common project obstacles.

Information on pricing, availability and content is available at [www.apress.com/us/book/9781484234976](http://www.apress.com/us/book/9781484234976).

## Springer books

Communicating with our targeted audience – **researchers, students** and **professionals** – and enabling them to work more efficiently, thereby advancing knowledge and learning, is one of our primary goals. Dynamic Project Management has been discussed in four books that are published by the flagship publisher Springer, and are available to the scientific and professional PM community:

**Integrated Project Management Sourcebook.** A technical summary book on project scheduling, risk and control containing +70 articles and a wide variety of test questions and model answers.

**Integrated Project Management and Control.** A summary book on the commonly used metrics in Earned Value Management and Schedule Risk Analysis, including performance reports and a P2 Engine tutorial.

**Dynamic Scheduling.** An overview book on baseline scheduling, risk analysis and project control, containing overview chapters, case studies and a tutorial for the ProTrack software tool.

**Measuring Time.** A project control research study awarded by the Belgian chapter of the Project Management Institute (PMI Belgium) and the International Project Management Association (IPMA).

Information on pricing, availability and content is available at [www.springer.com](http://www.springer.com).

## Online books

Sharing knowledge through a PM software tutorial as well as sharing work passion with our targeted audience is done at the OR-AS website by putting four online pdf books available for free download:

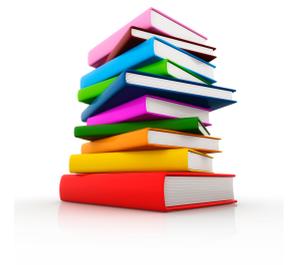
**Do Research, Create Knowledge, Feed your Talent.** A summary book on the research done at the Operations Research & Scheduling group, including article abstracts, book chapters and book summaries.

**Taking Sound Business Decisions.** The book that gives an overview of data analytics and mathematical programming methodologies to support and improve business decisions.

**The Art of Project Management.** An overview of the OR-AS products and services, the people who have inspired OR-AS, and above all, a book about work and passion.

**Dynamic Scheduling on your Desktop.** A Project Management software tutorial on how to integrate baseline scheduling and schedule risk analysis to facilitate and improve project control using ProTrack 2.0.

Free downloads are available at the bookstore of the OR-AS website at [www.or-as.be/bookstore](http://www.or-as.be/bookstore).



“If you only read the books that everyone else is reading, you can only think what everyone else is thinking” (Haruki Murakami)



### The Data-Driven Project Manager A Statistical Battle Against Project Obstacles

Business novel about a company in need for a better project management system:

- Plan, Risk, Buffer, Monitor and Control
- Based on case-based lectures given at universities and business schools



### Integrated Project Management Sourcebook A Technical Guide to Project Scheduling, Risk and Control

Technical guide for scheduling, risk and control of projects:

- + 70 articles
- Questions and answers available in the book



### Integrated Project Management and Control First Comes the Theory, then the Practice

Overview book on Schedule Risk Analysis and Project Control:

- Summary of Schedule Risk Analysis metrics
- Summary of Earned Value Management and Earned Scheduling Management



### Project Management with Dynamic Scheduling Baseline Scheduling, Risk Analysis and Project Control

Student handbook for the course project management (edition 2):

- Overview of project scheduling principles available in literature
- Use of software stimulated (students version available)



### Measuring Time Improving Project Performance Using Earned Value Management

Research book on Schedule Risk Analysis and Project Control:

- Introduction of ProTrack
- PMI Belgium Award (2007) and IPMA Award (2008)



### Do Research, Create Knowledge, Feed your Talent A Summary of Research at Operations Research & Scheduling

Overview book on academic research:

- Abstracts of academic and professional articles
- Summary of book chapters and overview of written books



### Taking Sound Business Decisions From Rich Data to Better Solutions

Overview book on mathematical programming and data analytics (edition 2):

- Introductory chapters on decision making methodologies
- Summary chapters on research and teaching, but also on real consultancy projects



### The Art of Project Management A Story about Work and Passion

Summary book on the work done at OR-AS and Ghent University (edition 6):

- New chapters on research, project data and online learning
- New student experiments and summary of research awards



### Dynamic Scheduling on your Desktop Using ProTrack 2.0 developed by OR-AS

Tutorial book for using ProTrack 2.0:

- Chapters on baseline scheduling, risk analysis and project control
- Can also be used for ProTrack 3.0 (only small changes)

# Measuring Time

## Using Earned Value Management

**“The only reason for time is so that everything doesn’t happen at once.”**

- Albert Einstein

The book **“Measuring Time: Improving Project Performance Using Earned Value Management”** is the first full book I wrote in my life, and it was an unforgettable experience with mixed feelings: I still remember the time and places where I wrote every little piece of the book, and I keep good memories of them. But since it was my first book, I often had a hard time structuring everything into one cohesive document (I have to admit this still is a struggle, even after having written several books!). It kept me busy during the weeks, and aloof in the weekends and holidays, sometimes with joy, often times with the frustration of not knowing how to proceed. Mixed feelings, indeed! But when I look back at it, it has become a book that literally changed my professional life. It all started with my regular visits to London at a period that I was searching for a way to extend my research field. Up to then, I focused solely on project scheduling, and I tried several side tracks to broaden my research scope.

At the London School of Economics, I initially started working on an academic paper on Management Accounting, which resulted in two papers in high-quality journals. Nice, but it was not the road I wanted to take. It was not that the research trip to Management Accounting was not inspiring or fruitful, it was rather that my heart was in the field of Project Management, and it was there to stay. So I decided to expand my research horizon in London, promising myself not going too far from my project scheduling research. I remember the (sometimes lonely) evenings in London in front of my laptop trying to simulate projects in progress and measuring how this progress could be monitored. I started all kinds of simulation experiments and extended my scope from project scheduling to risk management and project control. After some successful simulation experiments, I started a collaboration with Stephan Vandevoorde who was interested in the practical application of these academic results, and in 2006, we published our first joint paper in the International Journal of Project Management (Vandevoorde and Vanhoucke, 2006). It was the start of much more...

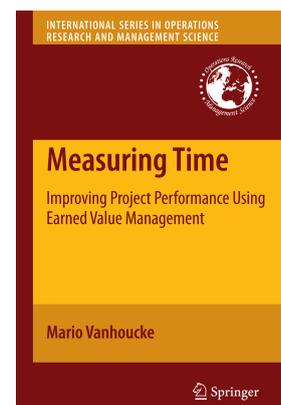
### A book about research

From that moment on, I decided to continue doing research on this interesting topic, and started to create a research environment at Ghent University (Belgium) where young and promising students could have a platform to collaborate with us. Before I realized it, I was working on a big research study on integrated project management and control with a focus on the validation of existing and new methods for Earned Value Management. Combining these new research ideas with my good old project scheduling research brought me to my new challenge: Data-driven project management.

Since the first publication in 2006, the regular visits to London were reserved to meet with people interested and experienced in managing projects. It was an intensive period with lots of computer experiments, visits to all kinds of companies and workshops to present new research results. In 2008, when most of the research was finished, I presented my work at the world conference of the International Project Management Association that awarded me for the work done. It was at that conference in Rome, just after my short but – to me – unforgettable presentation in front of hundreds of people, that I finally finished writing my first book. Extending my research horizon has been a struggle, but it meant the start of a new exciting journey that became the foundation of numerous publications and a number of follow-up books, each time extending this challenging new research topic into other interesting directions.

To those who are interested in reading the book: It is not written for dummies in Project Management, and the reader is assumed to have a certain background in simulation experiments and project scheduling. The book is intended to be a research book rather than a management book, but if you are interested in project management and earned value management, I believe that – after all these years – the book is still worth reading.

Read it, if you dare!



# Dynamic Scheduling

## Scheduling, Risk and Control

**“Everybody has a plan until they get punched in the face.” - Mike Tyson**

The book **“Project Management with Dynamic Scheduling: Baseline Scheduling, Risk Analysis and Project Control”** took me more than 10 years to finish. I started writing the first sections in Ghent (Belgium) when I was assigned to teach a Project Management course module at the Civil Engineering department. I urgently needed short summary articles to cover the topics I wanted to discuss in my class, and I felt I could not rely on existing books. While most books contained some of the topics I discussed, no book was available that covered the integration between baseline scheduling, risk analysis and project control. That’s why I decided to write my own book, focusing on the integration of scheduling, risk and control, and I referred to this integration as dynamic scheduling (based on a book I had read with the same title by Uytewaal (2005)).

### Integrating 10 years lecturing

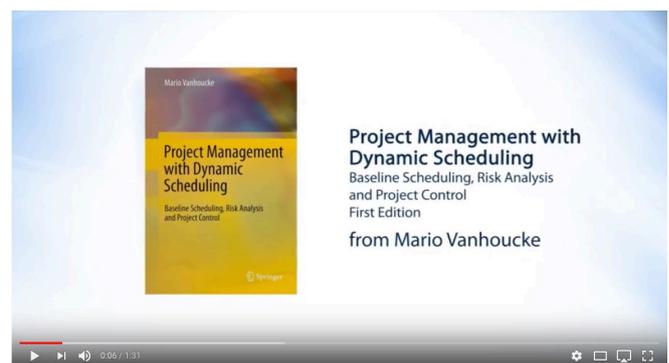
10 years to write one book? That’s a long period, but the writing process was one of focusing on writing, then forgetting, then much later returning and re-reading what I had so far and finally deciding that it’s not good at all, and starting from scratch again.

Initially, I had no intention to write a second book. I just wrote some small articles when I thought I needed them, and shared them with my students. I continuously changed and extended them as I updated my course module topics. After some years, I started to teach similar course modules for economic students in Belgium and Portugal, and after some time, I saw some of these draft articles on the desks of my students. They used my writings? What a (nice) surprise! That’s when I decided to write a full book about these topics, aiming at integrating the different articles I had so far. So it took indeed almost 10 years before I decided to integrate all the material into a single book for students.

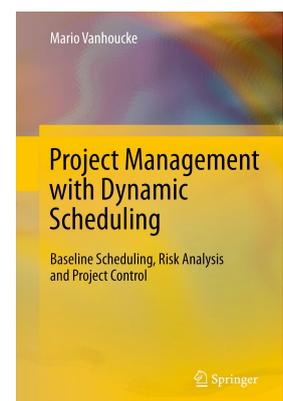
Unlike my other books, there is no particular place I can mention where I wrote this book, except everywhere. As I said, it has been a slow and gradual process, inspired by my students and my own research, which – eventually, almost accidentally – resulted in a book. The book really is intended to be a

student handbook, written for students at universities following a quantitative project management course module. I’ve never been a lecturer that follows chapters of a book, but the central idea of the new student handbook was – and still is – that the content can be used as background material with technical details and a summary of my lectures. Of course, I truly hope that the book cannot be used to replace my lectures, but rather serves as the ideal background material for those who follow my course modules and attend my lectures.

It’s up to my students to judge.



Watch Springer’s promotion video of this book  
[www.youtube.com/watch?v=9QygxAh93Og](https://www.youtube.com/watch?v=9QygxAh93Og)



# Integrated Project Management and Control

## First Comes the Theory, then the Practice

**“In theory there is no difference between theory and practice. In practice there is.” - Yogi Berra**

After two books about the same topic, I thought I had told everything I knew about quantitative project management, and I had no plans to write a third one. But my students thought otherwise.

Some of my MBA students were working on spreadsheets to monitor and follow up their projects, and they quickly realized that a correct implementation of all the methodologies discussed in class required detailed knowledge about formulas and statistical assumptions. And I didn't discuss these details in class. They really needed a book – so they told me – with a strong and clear focus on the underlying formulas of planning, risk and control, preferably illustrated on project examples. And so I started writing my third book **“Integrated Project Management and Control: First Comes the Theory, then the Practice”**.

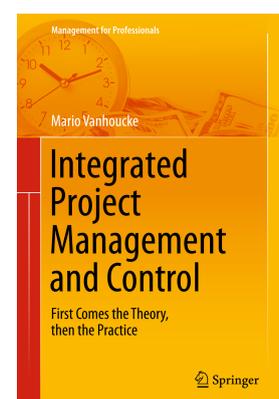
### Calculations are important

The book focuses solely on the detailed calculations of Earned Value Management and Schedule Risk Analysis. Each methodology is illustrated on three artificial projects in MS Excel. Working out three projects to the finest details is an intensive job, carefully done in silence, evening after evening, spending a lot of time behind my laptop. At that time, I was teaching a new Project Management course at University College of London (which is now one of my favourite course modules at UCL School of Management). It was January in a rainy London, and writing this book had something special: during the day, I was teaching to young and enthusiastic students, and in the evenings, I was writing down all exercises we've made in class (after I enjoyed some good food in London's Chinatown). On Saturday mornings, just before I had to take the Eurostar back to Belgium, I enjoyed the calmness of London (if you ever have the opportunity to walk in London on an early Saturday morning, you should do it!), jumped on the train and started new computer simulations and calculations.

I repeated this process for almost half a year before I could finish my book. It resulted in another special experience, and a new book about theory and practice of integrated project management and control.

This is not a book you want to read on a Sunday afternoon on your terrace with a glass of wine (when it's hot outside, I prefer Duvel instead of wine). No no. If you feel the need to read a nice and exciting story, with a great plot, a fantastic scene and intriguing events, then I recommend to you my all-time favourite “The House of the Spirits” by Isabel Allende. But if you are interested in how to create your own MS Excel file for managing projects, then you don't mind that the story is at times somewhat boring and mathematical.

In that case, I recommend my book to you. Forget the wine and keep a good and strong beer (as said, preferably Duvel) close to you while reading the book. You might need it.



# Integrated PM Sourcebook

## A Technical Guide

**“Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it.” - Samuel Johnson**

My fourth technical book about project management is inspired (once again) by many of my students. My learning platform [www. pmknowledgecenter.com](http://www.pmknowledgecenter.com) consisted of a series of small articles which were massively downloaded by my students. I received a lot of emails with requests to extend this learning platform with a sample of questions to test their knowledge and understanding. The moment the number of downloads exceeded 50,000, I decided to make a book out of the material I had on the website. The **“Integrated Project Management Sourcebook: A Technical Guide to Project Scheduling, Risk and Control”** has become the book which originally contained all the articles published at PM Knowledge Center, but gradually, it became more than just a collection of articles. As a matter of fact, from the moment I decided to write a book based on these separate articles, I knew it would be the hardest book I would ever write. The idea was that every little chapter had to be readable as a stand-alone article, accompanied by questions and solutions. It took me a lot of effort to structure the book in a good way, and I had serious doubts whether I had to continue with the articles from the website, or whether I should start all over from scratch.

And so I did start from scratch several times, every time throwing away what I already had. Writing a book is not a funny endeavour all the time!

No doubt that this book was the most difficult one to write, but I believe that it resulted in another (fourth!) book on quantitative project management that differs from the previous ones. This time, it had become a book for people in search for understanding the technical details and aiming at getting insight in the methodologies. The book is meant to be a technical guide for scheduling, risk and control of projects. It contains + 70 articles, with at the end of each article some exercises and answers that can be used for teaching purposes. People who are willing to test their understanding by answering the numerous questions at the end of each article might learn a lot about the underlying methodologies used in project management. Most of the Q&A chapters in the book

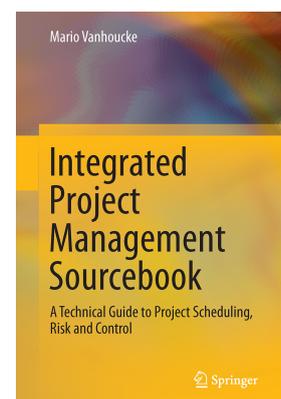
can be used as quizzes in the classroom, allowing any lecturer to immediately test the knowledge of today's class topic.

Despite the difficulties and hard time I had to write this book, I mostly enjoyed the writing process again. This time, I mainly had a good time while writing because of the special location. Much of the book's content was written during my stay in Lisbon in 2015. People who know me well know that I'm in love with Portugal's city of light. In the book's preface, I summarized this wonderful stay as follows:

### Portugal's city of light

This book has been written in the sunlight of Lisbon during my four months stay at the city of light. While artists say that light is all important to creating a masterpiece, I just think back on it as a period where I enjoyed writing in my apartment at Beco da Boavista, on the terraces of Jardim da Praça Dom Luis I (my favourite one, I called it the red terrace), Praça do Comércio and Portas do Sol but also on the Miradouro de Santa Catarina, the city beach of Cais do Sodré and of course at Universidade Aberta de Lisboa. In fact, it is my stay at the city that has become the masterpiece, while the book is simply the result of hard work in complete isolation from all Belgian distractions.

If you are interested in the technical details of data-driven project management, and you urgently need little exam questions to test your understanding, this book might be your ideal reference guide.



# The data-driven project manager

## A statistical battle against project obstacles

**“Maybe stories are just data with a soul.” - Brene Brown**

After four technical books about quantitative project management, I thought it was time for something else. Ever since I was a kid, I dreamt of writing a novel. I wrote several of them when I was in my teens, and I am happy I never showed them to anyone. But in the summer of 2016, I decided to go for it and combine my dream of being a real author with the experience of writing technical books about Project Management: I again moved to Lisbon for a few months and started writing my first technical business story entitled “The data-driven project manager: A statistical battle against project obstacles”.

Portugal’s city of light never disappoints. I was completely alone for a month, woke up every day very early and started writing on the terrace of my apartment. A cup of strong coffee, black, no sugar, music in the background and my computer. While the sun rose in the East, I wrote about the management of projects in a fictitious company. When the sun was hot in the afternoon, I searched for some shadow, thinking about the next chapter. When the sun went down, I was grateful with the day, thinking that I would never come closer to my teenage dream than what I was doing right now. I was writing a technical story, yes, almost a novel! What an experience! I would never have thought, when I was 18, that I would ever write a fictitious story in Europe’s most beautiful city. During this second stay in Lisbon in 2016 (my first one was in 2015) I came as close as I could come of becoming a real writer. It was a very lonesome period, missing my family every second of the day, but it was a very intense one. Intensity is beauty, so completely overwhelmed by the beauty of writing 15 hours per day in the sun, the book reminds me of what I already knew for years: I love the act of writing! Happy I was when my wife and kids joined me for the rest of the Lisbon stay, but writing in complete isolation is an experience that I recommend to anyone!

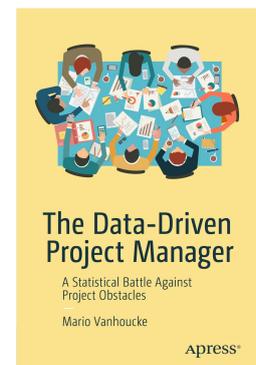
As said, this book is totally different from my previous books, although the topic is the same. The book is written as a narrative telling the story of a company that wants to install a data-driven methodology for managing its projects. It’s a story about people who struggle with the new quantitative concepts, but also about some other people who cannot wait to

implement the new system as soon as possible. It combines the explanation of the statistical methodologies (i.e. sound academic research) with the complexities and difficulties to use them in a real business environment (i.e. the practical relevance) in a single story of a company called GlobalConstruct Ltd.

### Storytelling

Storytelling may be trendy in marketing circles these days, but I was already convinced for a long time that storytelling works. After 20 years of academic research, consultancy and teaching all around the world, I have learned that every single person has his/her own way of understanding new (and often) complex topics. Young university students might prefer mathematical details and are not always very interested in the practical relevance, while the (somewhat) more-experienced students (MBA students, or company people) prefer to put these mathematical details into the right perspective, and rather aim at understanding the strengths and weaknesses of the underlying statistical principles. But no matter how students learn and what they aim for, it is the task of a teacher not only to provide them with new concepts and methodologies, but also to explain why these methodologies work in some cases and why they sometimes fail in other cases. Therefore, a good teacher should invite his/her students to join him/her in a journey and learning experience, and together, student and teacher, they should strive to obtain understanding and conviction that the discussed topics are relevant for the students’ future careers. Obviously, telling a story to put the different concepts into the right perspective works better than just focusing on the formulas and dry details of the methodologies.

Writing a fictitious story about managing projects was stepping out of my comfort zone. Not for the content of course, but certainly for the writing style. I’m an academic, not a writer! It was so totally new and different to me, that I decided to write more about it, which you can read in the article “Storytelling for project managers” on the next page of this book.



# Storytelling for project managers

## A technical novel

**“I’m actually a big fan of anecdotes in business.” - Jeff Bezos**

Project Management (PM) has been part of my professional life ever since my research for my PhD. Today, my focus not only lies on research and academic papers, but much more on teaching at business schools and companies. My audience consists not only of university students, but much more of professionals active in the PM field. These professionals are often responsible for huge projects, and need to take decisions along the life of the project to maximise the likelihood of project success. For them, relying on data is key for making good decisions! And that is what the book is all about.

The book “The data-driven project manager” is about a fictitious company called “GlobalConstruct Ltd.” that is responsible for a tennis stadium construction project in Australia. The book tells the story of Emily Reed and her colleagues who are in charge of the management of a new tennis stadium project. The CEO of the company, Jacob Mitchell, is planning to install a new data-driven project management methodology as a decision support tool for all upcoming projects. He challenges Emily and her team to start a journey in exploring project data to fight against unexpected project obstacles.

Before you dive into the book and start reading the story about GlobalConstruct’s tennis stadium construction project, here is a short summary of the reasons why this book might be relevant to you. I also give a summary of each of the chapters such that you know what to expect. So, if you are a PM professional, and you are wondering whether this book will be worth a read, please read the next sections and then decide.

### Why should you read this book?

This book is written for both students and professionals. It’s written for all project managers with an affinity for data and with not much time to dive into the expert literature. It’s written for professionals with or without expertise in data-driven project management, but with an eagerness to learn more about the use of data-driven methodologies for their projects.

After several scientific books on project management, I thought it was time for something else! It’s not that I don’t like the scientific content of my previous books, but I noticed that scientific books are written for... well... scientific people. Professionals hardly get access to these books. They are not written for professionals anyway, but rather for academics and researchers. But this time, with my new book, it’s different!

My book is written for professionals, very much similar to my teaching sessions that are given for people with practical experience. As a matter of fact, my professional teaching sessions, including the discussions I had with my students, were my main inspiration for writing this book. One of the main challenges in training professionals is the translation of the scientific insights into practical relevance. You need to build up a story with practical examples, case studies, references to new methodologies and practical tips and tricks on how to implement the new tools. No advanced scientific material only, but primarily practical knowledge ready to be used by the professionals that are willing to learn. And that’s why I decided to write another type of book: not a summary of dry formulas, but a technical story with fictitious characters. I’m proud to say that this is my first technical business novel about data-driven project management! And to the best of my knowledge, no-one has written such an integrative story about scheduling, risk and control before.

### Why a data-driven approach?

A data-driven project management methodology allows project managers to plan, monitor, and control projects while delivering them on time and within budget. It is well known that data can help professionals to make better decisions. In PM, data analysis is necessary for risk analysis, and for understanding how actions can be taken when uncertainty endangers the project. It’s about the clever use of data to support better decisions. As said by Edward Deming: “Without data, you’re just another person with an opinion”. Data-driven project management aims at combining best of both worlds: Mix facts [data] with experience [opinions] and make better decisions along the life of your projects!

## Why the integration between schedule, risk and control?

The main focus of the book lies on the integration of three crucial dimensions of project management: baseline scheduling, schedule risk analysis, and project control. A baseline schedule is a project plan that acts as a point of reference for (i) analysing the project's risk and (ii) controlling the project's performance when it's in progress. The integrative character of this book is its biggest selling point, as it shows that the proper use of data in each of the three parts (schedule, risk and control) allows the project manager to make timely decisions when projects are in danger. This integration is based on my previous (scientific) books, and is called "dynamic scheduling" in the literature.

## Why a business novel?

The use of a fictitious story allows me to imitate the discussions I often have when teaching to a group of people in a company. Teaching is about discussing new ways of managing projects, and about having different views on different methodologies. There's no right or wrong answer. It's about discussing and sharing different views to come to a collective agreement and an improved system that can be used by everyone in the company!

## What is the lesson to learn?

The main lesson to learn is that data can help making better decisions when managing projects. Data cannot replace human intuition, but can certainly support human decision making when used in a correct way. The story shows that the correct use of data for managing projects leads to improved results, not only measured by the quality of the decisions (i.e. the impact of the decisions on the project objective) but also by the effort the manager has to spend before the data can be properly used. In other words, you will learn how to become an efficient project manager, i.e. one that uses project data and implements new technologies with the lowest possible effort while obtaining the highest possible quality. This so-called "control efficiency" concept is the core lesson-to-learn in the book. Based on research, and practice.

## How to implement the lessons-learned?

The book gives examples on how to implement the different methodologies into a spreadsheet, and displays some easy examples of how the company (GlobalConstruct) has done it. No rocket science or advanced tools, but rather simple and easy-to-implement tools and project dashboards. An example dashboard integrating scheduling, risk and control is given in the example dashboard given in the figure of this article.

## BOOK CONTENT

Written as a technical business novel, this book demonstrates the highly interactive discussions among the main characters of a team responsible for a challenging project. It allows the reader to participate and consider options — as a project manager would — at each stage of a project. The main characters of this story and the company they work for are briefly introduced in Chapter 1 .

Chapters 2 through 7 tell the story of Emily Reed and her colleagues, who are in charge of the management of a new tennis stadium construction project. Most of these chapters can be used in any data-driven project management lecture for university students, MBA students, and professional project managers.

The first part of each chapter always ends with an "action list summary" in a section entitled "Assignment". The text of each chapter, up to and including this assignment, can be used as a case study to be solved and discussed by anyone with an interest in data-driven project management. I use these case studies in my project management lectures at several universities and business schools, as well as in company trainings. But as a reader of this book, you can also use each chapter's assignment as a challenging exercise to test whether you understand the relevance of data-driven methodologies for your own projects.

The second part of each chapter contains the solution to each assignment. I use this as a general framework for my feedback sessions to kickstart a discussion about the case study. For you, dear reader, it can be a tool to check whether you have solved each chapter's assignment correctly.

In Chapter 8 , I have provided references to academic papers and technical books that were my main inspiration for writing this book. I have tried to keep the technical details out of the story as much as possible. So, this book is not only a story about data and projects; it's intended to be a reference tool for applying the newly presented concepts in practice and also (if desired) for diving more deeply into the advanced material presented in the afterword.

As a matter of fact, many of the chapters were initially a loose collection of exercises and case-study drafts before they were brought together into a book. The first part of each chapter has been tested, revised, sometimes completely rewritten, and finally fine-tuned in various project management lectures at Ghent University (Belgium), Vlerick Business School (Belgium), and the UCL School of Management (UK). The valuable feedback that I've received from students and project managers has been carefully taken into account and has contributed to the final version of this book.



# Research



# The Nature of Research

**“Research has a very forward looking attitude and success comes from failing and subsequently, from understanding the failure.” - Walt Lipke**

Research is a discipline which is so fundamentally different from daily business practice, that the gap between academics and professionals is often so big that they do not understand each other. While business mainly focuses on short term results in line with the longer term strategic goals, research has a very forward looking attitude and success comes from trying and failing and subsequently, from understanding the failure.

Despite the fundamental differences, I believe that the gap between the two worlds must be seen as a unique opportunity to inspire each other. Academic research is an act that originates from scientific curiosity and is used to establish or confirm facts, to reaffirm or reject the results of previous work or to solve new or existing problems. However, it should be done in such a way that it makes practical applications possible, and that it creates a certain awareness to the business manager that the results can help moving the professional world forward.

I recognize that many research results must stay between the walls of an academic environment. They must primarily be used to challenge other researchers helping them formulating new research questions or finding new challenging problem formulations. However, a certain degree of knowledge transfer from the academic endeavors to the professional world is key to the success of research. Research that is applied within real-world setting stimulates critical thinking, and facilitates the acceptance of research fundings and brings the many interesting results to a broader audience.

One of my biggest challenges as an academic is to contribute to this knowledge transfer in Project Management through research in various ways. In this chapter, a short overview is given of our research endeavors at our research group.

## Measuring Time (2001 - 2008)

The original intention of the work that has finally led to the book “Measuring Time” was to objectively compare the existing project control techniques and validate their performance on a huge fictitious project database. Inspired by the work of Walt Lipke (US), I felt the urge to touch the project control theme from a more academic point-of-view.

The purpose of our research was not only to show that certain project control tools and techniques work or not, but rather to illustrate how they work and in which cases they are more reliable than in other cases. Thanks to this research, I was able to objectively validate, confirm and/or reject the many often conflicting statements about project control techniques spread all over the literature.

In 2008, the book was submitted and finally published by Springer, and awarded by the International Project Management Association (IPMA) on their world congress in Rome. Somewhat later, in 2009, Tony Barrett, a project management professional, wrote the following quote on LinkedIn “Finally, I understand why EVM works so well in some cases and fails so miserably in others”. The research had found its way to the PM professionals. Mission accomplished!

## Dynamic Scheduling (2008 - 2011)

After the publication of the first book, a lot of presentations have been given in various countries, for academics, practitioners, on research conferences as well as during business trainings. During all these presentations, it became more and more clear that the relevance of using project control techniques described in the first book can only be fully understood if project control is integrated with project scheduling methods and risk analysis tools.

Therefore, writing a second book “Dynamic Scheduling” was almost a natural next step, since it aims at giving a complete overview of the scheduling techniques and risk analysis tools integrated in a project control approach.

Mario: “At the period after the publication of Measuring Time, we were with OR-AS in the middle of the development of a third version of ProTrack as an integrated tool for project managers, and the development of ProTrack and writing the various chapters of the book felt like an integrated process and

necessary condition to enable the use of ProTrack in my Project Management course”.

The book has been published in 2010 by Springer and is used at universities and business schools as a handbook for students, researchers and professionals with an interest in the integration of scheduling/risk/control in Project Management.

**Theory & practice (2011 - 2014)**

With the two previous books published, it looked like it was time to stop writing about the same topic. But upon request of MBA students and participants of commercial PM trainings, I started with ideas for a third book that should be fundamentally different from my two previous books. It has finally resulted in the book “Integrated Project Management and Control: First comes the theory, then the practice” which holds the middle ground between the methodological details of the research book “Measuring Time” and the general overview descriptions of the student handbook “Dynamic Scheduling”.

It has a rather technical scope containing formulas and mathematical details on the calculations of the EVM/ES and SRA metrics, as well as some guidelines to make researchers and practitioners ready to use the concepts of the book, using three illustrative examples.

**A technical guide (2014 - 2015)**

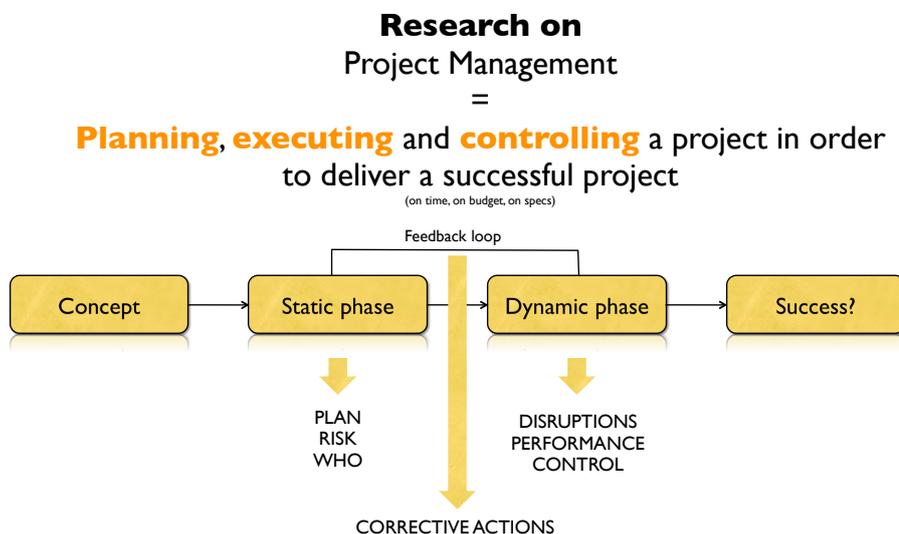
During my stay in Lisbon in 2015, I assembled everything that I had written on the online PM Knowledge Center, and extended it with questions and answers and submitted it to Springer. It became the book “Integrated Project Management Sourcebook: A technical guide to project scheduling, risk and control” which gives an almost complete overview of the topics of my course modules in a short and understandable way.

**Concerted Research Action (2011 - now)**

Doing research lies in the heart of any academic institution and the knowledge transfer from research results to practical rules-of-thumb in business is, or must be, a continuous never-ending process. Therefore, research must be seen as an investment in the future, funded by organizations that recognize that research goes hand in hand with trying and failure. Both successes and failures have to be seen as expectations in the search for something new, and not something to be seen as waste.

The research at our research group is done by young and passionate people, in collaboration with a promotor and members of other (national or international) universities. Therefore, finding fundings for research is one of our major concerns to produce a continuous flow of research results. It gives us a way to further objectivize the various opinions on Project Management, to critically analyze current project control systems and to validate best practices and even to improve them by combining our academic knowledge with the practical needs.

In 2011, a big international Project Management research project has been granted to Mario Vanhoucke from Ghent University (Belgium), in collaboration with the George Washington University (US), University College London (UK) and CERN (Switzerland). The project is funded by Ghent University (> 1 million euro) and guarantees a yearly entrance of new young researchers in our research group between 2012 and 2018. The collaboration between the experts across the world helps us grow and become better. It gives us a way to continue in what we do ... aiming at narrowing the bridge between research and practice.



# The Journal of Modern Project Management

## Enhancing theory and managerial significance

**“To get to know, to discover, to publish – this is the destiny of a scientist.” - François Arago**

There aren't a lot of academic journals with a peer reviewed process available for academic researchers on Project Management (PM).

Often, our research is published in Operations Research journals since the main novelty of our research lies in the methodology and solution technique developed during the research. But at other times, the research contribution is so much linked with PM that the methodology is not an end but a means for investigating new theories or validating and comparing existing PM practices. For these research endeavors, the ideal outlet is a PM oriented journal.

Therefore, the work is then submitted to the International Journal of Project Management or the Project Management Journal. But only recently, a third player entered the market, the Journal of Modern Project Management. While its development is still in its infancy and the journal name is not yet widely known, I believe it deserves attention.

### The journal

The **Journal of Modern Project Management** (JMPM) is a quad-monthly basis scientific journal of studies focusing on the area of project management necessary to promote a balance between theory and practice, highlighting case studies on different sectors. Papers are reviewed by a double-blind review system.

The mission of the JMPM is to advance knowledge and science and to stimulate greater thought and effort in the fields of PM theory and practice by providing readers with:

- New and helpful information
- New PM theory or techniques
- Research generalizations about PM thoughts and practices
- PM understanding by researchers as well as practitioners
- Creative views and syntheses of dispersed concepts in PM

- Articles in subject areas which have significant impact on thought and practice in PM, which present challenges for the future.

The focus of articles for the JMPM lies on the managerial situation or the theory being studied rather than the solution techniques being developed or used. Highest priority is thus given to studies that are anchored in the real world and build, extend or test theories or frameworks of managerial significance. Most often such studies result from either identifying an actual, new managerial situation for which existing theories are inadequate - thereby resulting in an addition to theory - or else testing multiple existing theories against actual managerial situations to determine their relevance - thereby enhancing theory through subtraction.



With Osmar Zózimo during his visit in Ghent  
(July 8, 2014, Ghent, Belgium)

### The board

The editorial board of the journal consists of a very diverse team of international experts from various countries all over the world. The academic editor is Steven Eppinger from MIT Sloan School of Management (United States). The team also consists of two EVM Europe members, Pierre Bonnal and

myself, as well as friend and colleague Young Hoon Kwak from The George Washington University (United States). All members can be viewed at the journal's website [www.journalmodernpm.com](http://www.journalmodernpm.com).

### Editor-in-chief & Publisher

Editor-in-chief is Osmar Zózimo De Souza Jr. from Brazil, who is also responsible for the Mundo Project Management magazine promoting the state-of-the-art knowledge on Project Management in Brazil.

Osmar visited me in Ghent in the summer of 2014, together with his son, and we talked about the promising future of the journal. As a nice detail: Osmar has studied at the Pontifical Catholic University of Paraná, located in the State of Paraná in Brazil. It is probably a coincidence, but the three bridge construction case studies published in the book "Dynamic Scheduling", known as the Mutum-Paraná II Bridge project case studies (A, B and C) are also located in the state of Paraná. What are the chances?

### Publications

The OR&S group of Ghent University has several publications in the JMPM, as given in the list below. These papers can be downloaded from [www.or-as.be/journals](http://www.or-as.be/journals).

- Vanhoucke, M., 2014, "Teaching Integrated Project Management and Control: Enhancing student learning and engagement", Journal of Modern Project Management, 1 (4), 99-107.
- Vanhoucke, M., 2014, "Blended learning in Project Management: An overview of the Operations Research & Scheduling group", Journal of Modern Project Management, 1 (3), 108-121.
- Vanhoucke, M., 2013, "Project baseline scheduling: An overview of past experiences", Journal of Modern Project Management, 1 (2), 18-27.
- Vanacker, L., Van Raemdonck, O., Servranckx, T. and Vanhoucke, M., 2018, "The influence of project resource allocation on the resource capacity of the business processes", Journal of Modern Project Management, 6(2), 6-17.
- Andrade, P. and Vanhoucke, M., 2017, "Combining EDM and EVM: A proposed simplification for project time and cost management", Journal of Modern Project Management, 5(2), 94-107.
- De Koning, P. and Vanhoucke, M., 2016, "Stability of earned value management: Do project characteristics influence the stability moment of the cost and schedule performance index", Journal of Modern Project Management, 4(1), 8-25.
- Vanhoucke, M., Coelho, J. and Batselier, J., 2016, "An overview of project data for integrated project management and control", Journal of Modern Project Management, 3(2), 6-21.
- Vanhoucke, M., 2015, "On the use of Schedule Risk Analysis for Project Management", Journal of Modern Project Management, 2 (3), 108-117.
- Vanhoucke, M., 2015, "Controlling projects", Journal of Modern Project Management, 3(1), 5-5.
- Vanhoucke, M., 2014, "Praise youth and it will prosper: PMI Belgium's recognition of young PM potential", Journal of Modern Project Management, 2 (2), 112-117.



The Journal of Modern Project Management  
(January - April, 2015 issue)  
[www.journalmodernpm.com](http://www.journalmodernpm.com)

# Concerted Research Action

## Demonstrating scientific excellence through collaborative efforts

Each year the Flemish Government allocates research funds to Ghent University so as to implement the Flemish Government's Resolution of 8 September 2000. Concerted research actions are research projects with a duration of four to six years of which the scientific excellence can be demonstrated on the basis of objective data – more specifically on the basis of publications and other indicators that show the scientific quality of the research group(s) in question.

### Research

In 2011, the research proposal submitted by Mario Vanhoucke titled "Searching for static and dynamic project drivers to predict and control the impact of management/contingency reserve on a project's success" has been awarded after a review process and a final presentation to the jury. The acceptance of this proposal leads to a 'more than a million euro' research project on Project Management in collaboration with the George Washington University (US), University College London (UK) and CERN (Switzerland).

The three research lines are centered around the project control phase, and can be briefly summarized as follows:

- Dynamic scheduling: Static integration of baseline scheduling and schedule risk in the project control phase.
- Dynamic progress: Integration of dynamic resource disruptions and/or instabilities during project progress.
- Statistical and analytical control: Setting and maintaining the management and contingency project reserves using statistical project control limits as well as analytical buffering methods

### Methodology

The Operations Research methodology used in the research will consist of a well-balanced combination of combinatorial optimization, simulation experiments and the statistical analysis of the resulted data, using the advanced PM calculator P2 Engine developed in previous research studies.

### Results

The research results will be spread on conferences, such as the [www.evm-europe.eu](http://www.evm-europe.eu) conference and the two-yearly workshop on [Project Management and Scheduling](#). Final results will be submitted to international flagship journals in the field of Project Management and Management Science. The aim and ambition is to write top academic papers as well as more practical oriented guidelines that bring value to the project management discipline.

Since academic research should always start from a deep understanding and knowledge about the current state-of-the-art, an overview paper on project control has been written published in the International Journal of Project Management entitled "Classification of articles and journals on project control and earned value management" [2015, Vol. 33, Issue 7, Pages 1610-1634].

**Advisor:** Mario Vanhoucke

**Title:** Searching for static and dynamic project drivers to predict and control the impact of management/contingency reserve on a project's success

**Date:** 2011 - 2019, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021)

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# IPMA Global Research Award



## And other awards

**“It doesn't matter how many times you win an award, it is always very special.” - Zinedine Zidane**

### Rome, Italy, 2008

In 2008, most of the research of my upcoming book “Measuring Time” was finished, but I was still not convinced that my results had more than academic value. I did not know how to disseminate the research results. I could do it in the traditional way, aiming at publications in academic journals. I could do it in a slightly different way: writing a book. Or I could try to share my research results with a bigger audience, aiming at reaching professionals. I chose to do it all.

And so I submitted a proposal to get a research award from the prestigious International Project Management Association (IPMA), without a lot of expectations.

Some time later, the good news followed!

At the World congress of the IPMA conference in Rome (Italy, 2008), I received the **IPMA Research Award** for my study on project control with Earned Value Management and its integration in the OR-AS software tool ProTrack. Unbelievable! Research meets practice!

I will never forget the moment I was on the stage presenting my research. Back in 2008, I was a young kid of 35 years old :-), not used to talk to an audience bigger than a few hundred people. This time, there were many more. All professionals. How I enjoyed these 15 minutes of fame!

More important than the award, on that day, I have met Professors Young Hoon Kwak and Frank Anbari from the George Washington University for the very first time. We knew each other, of course, but only via emails and reputation. Professor Kwak has since then visited us on a regular basis for being part of the jury of PhD defences. I do not exaggerate when I state that this research award has fundamentally changed my career, in a very good way!

### Berlin, Germany, 2020

More than 10 years after my first IPMA award, I thought my research had evolved a lot and resulted in many new exciting insights.

“Good things come in pairs”, I must have thought, when I submitted my new research results to IPMA again in 2020. This time, I was no longer on my own, but submitted the award together with my colleagues José Coelho, Jordy Batselier, Annelies Martens, Tom Servranckx and Gaëtane Beernaert.

And again, some time later, good news followed!

Normally, the ceremony would have been held in Berlin (Germany), but COVID-19 had other plans with us. There was a short online ceremony in a very nice “Eurovision Song Contest” style. All award winners can be found at IPMA’s wall of fame (<https://www.ipma.world/about-us/wall-of-fame/>)

## Testimonials



**Prof. Dr. Mario Vanhoucke**  
*IPMA Research Award Outstanding Contribution 2020*

The IPMA research award is one of the most prestigious awards in the field of Project Management. IPMA awarded my research for a first time in 2008, and this award enabled me getting a research grant of 1.3 million euro from Ghent University (Belgium). With that grant, I created a team of researchers to explore new research ideas between 2011 and 2019. The second IPMA award in 2020 couldn't come at a better time! It recognised once again the quality of my past research, and it certainly will stimulate my team to continue for another decade.

**Other research awards**

Throughout the years, I had the privilege to get recognition for my research through various other awards:

The **PMI Belgium PhD award** (2018) for the PhD of Annelies Martens entitled "Buffer management methods for project control", Brussels, Belgium.

The **Elsie Cropper award** (2017) for the paper entitled "In pursuit of more accurate project forecasts: Integration of earned value management with exponential smoothing and reference class forecasting" at the Young OR Conference in London, UK.

**Notable Contributions to Management Accounting Literature award** (2011) for the outstanding contribution to the management accounting literature by the American Accounting Association for the paper "A Simulation Analysis of Interactions among errors in Costing Systems", Denver, USA.

The **PMI Belgium Research Collaboration award** (2007) to fund the research for the upcoming book "Measuring Time".



The 35 years old me with Young Hoon Kwak and Frank Anbari from the George Washington University (Rome, 2008)



My "15 minutes of fame" in Rome, seeing myself on the screen 10 times bigger than I actually am. I never have worn a costume again.



For a summary of the research that resulted in my second IPMA research award in 2020, watch the video at <https://youtu.be/wuPhLaLwbJs>

# Sabbatical

**“I'm going to sleep well tonight knowing that I made the right decision.” - Robert Schuller**

## Lisbon

In 2014, I was thinking to leave Ghent for a while. Not much later, I got the opportunity to stay in Lisbon for 8 months. This decision to stay in the city of light changed my life for good.

A sabbatical is supposed to be a period where you go away for the daily operational activities to think about the past and future, to reflect on what has been done and to outline a new, refreshed path for the coming years. It is supposed to be a period with no stress, low activity level, no meetings and no pressure to teach or publish. However, nothing of that was what I really needed. That kind of sabbatical was certainly not what I was looking for.

But I went to Lisbon anyway. I loved the city from the very first time I've been there (and ever since, I visited it almost every year), and I had met Prof Dr José Coelho (who wasn't a professor yet the day I met him). He is known as a super-clever, very enthusiastic, hard-working researcher, with a passion for project scheduling, a never-ending drive for searching for new opportunities, and a real no-nonsense style. That's the type of guy I like to work with. After 10 years of collaborations, mainly via Skype and regular short visits, we finally worked together in Lisbon, where this colleague gradually turned into a good friend.

## Research

I don't think I've ever worked harder as during my two periods of stay in Lisbon (in 2015 and 2016). At the same time, I fully enjoyed every part of life at this beautiful city. It was the ideal combination of work and pleasure, with lengthy meetings from dusk till dawn, with days of writing and programming, and occasionally with a day-off during the weekend.

**2015:** In 2015, José and I worked on a branch-and-bound procedure for solving the resource-constrained project scheduling problem with different algorithms, and published a paper on the use of data in project management. Hard work with lots of fun. In between our interesting meetings, I wrote the book "Integrated

## Research in the city of light

Project Management Sourcebook: A technical guide to project scheduling, risk and control" that is published by Springer.

**2016:** In 2016, we wrote a second paper on the use of data for project management, and worked on an algorithm to investigate the impact of setup times in projects.

## Beyond research

It goes without saying that we did more than just writing and programming. We have spent some warm summer evenings without our computer, but instead with a good fresh Super Bock (= beer) on one of the many beautiful terraces in the city. An occasional visit to Cascais, Estoril and Cabo Espichel (my favourite!) was welcome to escape from the bits and bytes of our computer. We sometimes visited these places with just the two of us (and then continued talking about our research), but the visits together with our wives were a welcome change to the busy days.

The most challenging adventure beyond our research activities was undoubtedly the TV interview and the research overview we gave in one of Lisbon's well-known studios.

TV interview:

[www.youtube.com/watch?v=Ok41zf8FHf4](http://www.youtube.com/watch?v=Ok41zf8FHf4)

Data overview:

[www.youtube.com/watch?v=QwyBs\\_TJMYo](http://www.youtube.com/watch?v=QwyBs_TJMYo)

As Bryan Adams once said: Those were the best days of my life!



TV interview at Lisbon about my research stay at the Universidade Aberta in Lisbon and INESC – Technology and Science in Portugal.

[\[www.youtube.com/watch?v=Ok41zf8FHf4\]](http://www.youtube.com/watch?v=Ok41zf8FHf4)

# New research from abroad



## Challenge accepted

After almost 20 years of academic research with wonderful PhD students from Belgium, I thought it was about time to accept a new challenge. In the last decade, I have met numerous young Chinese students with an interest in research. These people have a strong background in analytics, are eager to learn, are sometimes a bit naive in their expectations (you need this trait when you're young) but have no problem in working hard.

In October 2017, I started to hire new PhD students from abroad, and decided to train them in carrying out academic research. Some of them come from China funded by the China Scholarship Council, and others from Iran and Turkey. A challenge it is, for the new students, for my (mainly) Belgian team, and for me. Much of the work is carried out together with colleague and friend José Coelho, and in collaboration with Zhengwen He (Xi'an Jiaotong University) and Jingwen Zhang (Northwestern Polytechnical University, Xi'an) (cf. article "Moving to the South: Welcome to Xi'an" in this book).

Meet my new PhD students from Belgium and abroad:

### Improving priority rules

Jingyu Luo comes from China and will try to improve the priority based scheduling rules often used in project planning software tools. Fast and easy tools to plan projects, are they still valuable in these powerful computer times? Let's find out!

### Machine learning for scheduling

Weikang Guo comes from China and is interested in machine learning, and explores paths to incorporate these techniques in project management. Can we use machine learning and artificial intelligence to schedule projects? We'll see!

### Project risk response strategies

Izel Unsal comes from Turkey and has already gained experience in risk response strategies. Her study assumes that these risk events occur due to various possible combinations of two variables: risk factors and certain managerial actions, either taken or mistaken.

### Project portfolio planning

Dries Bredael is from Belgium, just like me. Since we have worked for decades on resource-constrained

project scheduling, he will extend this topic to portfolio planning with shared resources. A challenging and also very relevant topic.

### Flexibility in projects

Rojin comes from Iran and will continue the work on flexibility in projects. She will develop heuristic algorithms for the so-called resource-constrained project scheduling problem with alternative subgraph. What a challenge!

### Uncertainty in project control

Forough also comes from Iran, and will continue our research line on project control under uncertainty. Her focus will lie on integrating statistical analyses into corrective action taking during project control. Not easy!

### Results

The research is currently in the exploration phase, or for some studies, already under construction. Results of experiments and references to newly written papers will be available soon and will be discussed in the next edition of this book. Stay tuned for more!

#### Research projects

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# Predicting Problem Complexity

## Theoretical understanding

In most of the research studies, the hardness of the well-known resource-constrained project scheduling problem (RCPSP) is expressed by the time it takes for a specific algorithm to find the optimal schedule. Such an algorithm is called “exact” since it theoretically guarantees to find an optimal solution, but in practice it often requires a lot of time to evaluate all possible solutions. In the current research proposal we want to deviate from this experimental approach, as it contains a fundamental flaw. If an algorithm needs a lot of time to solve a problem, it could either indicate that the project is indeed hard to solve, but it could also mean that the algorithm is not well designed. The current research proposal therefore takes a fundamentally different approach, and focuses on a profound theoretical argumentation instead of an experimental one.

## Research

The general aim of this research project is to create an integrative framework that describes the inherent complexity of the **resource-constrained project scheduling problem** (RCPSP) under different objectives. The complexity will be investigated along three dimensions: **network** logic, **resource** constraints and **objective** functions. The research is carried out in four phases: First, the concepts of a network and resource constraints will be studied from a mathematical (instead of an experimental) point-of-view, enabling the development of new complexity measures with a higher predictive power. Second, these complexity measures will be validated with a new lattice-based methodology that is independent from the solution procedure. Third, the impact of the objective function will also be investigated, which is largely ignored in most previous studies. Finally, the insights of the problem complexity obtained in the first three steps of this research will be used to develop a new and fundamentally different solution approach to solve the RCPSP.

## Methodology

This research is very technical and selecting the right methodology is a huge challenge. The methodology will consist of [1] finding a fast way to enumerate the number of permutations in any given network (based

on a so-called x-dimensional lattice), [2] theoretically showing that this number of permutations is a better indicator of problem complexity and [3] experimentally comparing this new complexity measure with the currently existing ones in literature. None of these rely on the concept of permutations but rather on simple calculations using the number of activities (nodes) and precedence relations (arcs). The methodology presented is now independent from the solution algorithm to solve the RCPSP, which is the ultimate goal of this study. Afterwards, this approach will be empirically validated by comparing the obtained results with the traditional network complexity measures known in literature.

## Results

The research has started in October 2017 and is therefore currently under construction. In October 2018, Rob has received research fundings for the research proposal “The resource-constrained project scheduling problem: Predicting problem complexity and enhancing solution algorithms”. Results of experiments and references to newly written papers will be available soon and will be discussed in the next edition of this book.

### Research project

**Researcher:** Rob Van Eynde

**Advisor:** Mario Vanhoucke

**Date:** Research currently in progress

**Funding:** Bijzonder onderzoeksfonds (BOF 01D01418)

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# Resources, Skills and Teamwork

## Investing in people

Investments in development and training of human resources is a critical part of people management and of the project's success. In recent years, service organizations as well as manufacturing organizations have been downsizing their resource pool. This change was induced by the recent increasing need in flexibility and versatility of workers, and resources have to continuously learn new skills and acquire new competences. Workforces have become leaner and are filled with multi-skilled, or cross-trained resources. They often possess a diversified set of skills that can be applied to a range of different activities. This new focus on skills, competences and their objectives is generated by the strategic advantages against competitors they bring about.

## Research

The problem that we will tackle is a **multi-skilled extension of the resource constrained project scheduling problem (RCPSP)**. In the classic version of the RCPSP, workers are assumed to be identical and master the complete skillset, whereas the workforce in the multi-skilled RCPSP has a heterogeneous skill-mix. In the so-called multi-skilled RCPSP, abbreviated as MSRCPS, multi-skilled workers do not have the skills to work at every activity of the project. In comparison to single-skilled resources however, this workforce can be assigned to a broader range of tasks and is therefore more flexible. This flexibility increase, together with other advantages, depends on the size and characteristics of the pool of multi-skilled resources.

The multi-skilled aspect is characterized by two concepts: depth and breadth. Depth refers to a deeper knowledge and understanding as well as a higher proficiency an employee can have for a certain skill. Breadth is, in turn, more about understanding the different components of the project and recognizing how the different components fit together. In a project environment, the breadth of a resource is perceived as the amount of skills an employee masters.

## Methodology

The workforce assignment and project scheduling parts of the MSRCPS have been solved sequentially in all of the research. In the current research study,

various ways of integrating these two subproblems will be proposed. More precisely, the following three different methodologies will be compared:

- The **sequential approach** separates the assigning and scheduling problems and uses the solution of one as external input for the other problem.
- The **semi-integrated approach** will keep the two problems isolated, but the assignment problem will consider scheduling constraints, to make the staffing adjusted to the possible schedules of the project.
- The **fully integrated approach** considers the two problems simultaneously.

While solving this challenging problem, conflicts between the workforce assignment plan and the project scheduling phase might occur. To deal with these conflicts a satisfiability (SAT) solver will be used to support the resource assignment, which is essential because the chosen resources affect the task duration. By solving this problem using SAT, possible conflicts that might pop up during project scheduling will be solved much easier, since SAT is widely known as a typical optimization tool for problems with these kinds of conflicts.

## Results

The research has started in October 2017 and is therefore currently under construction. Results of experiments and references to newly written papers will be available soon and will be discussed in the next edition of this book.

### Research project

**Researcher:** Jakob Snauwaert

**Advisor:** Mario Vanhoucke

**Date:** Research currently in progress

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021) and National Bank of Belgium

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# Allocating Budget for Project Risk

## Risk prevention, risk protection, or both

Risk is inherent and inevitable during project execution. Its occurrence often leads to adverse impacts on the project and even the failure of the project. In order to ensure the successful completion of the project, **risk prevention** aiming at reducing risk probability and **risk protection** used for decreasing risk loss should be taken to cope with the risk. Given the different effects and costs of these two strategies and the limited project budget, the project managers should be able to reasonably divide the budget among these two strategies.

### Research

The aim of the research study is to propose various managerial insight to make better decisions on risk response budget allocations, by answering the three following questions:

- How to make decisions on budget allocation among risk prevention and risk protection strategies?
- What is the impact of the risk and response characteristics on the budget allocation decision?
- How to allocate response budget among risk prevention strategies and among risk protection strategies with multiple risk causes and risk consequences?

### Methodology

The methodology consists of a mix of analytical calculations and combinatorial optimization methods, and is carried out in three phases.

First, an analytical model for budget allocation in risk prevention and risk protection is developed using linear and nonlinear risk functions. Secondly, an optimization model for allocating a risk response budget based on fault tree analysis is presented and tested on artificial and case study data. This model assumes that a project risk is generally triggered by a combination of multiple risk causes with probabilities to happen, and its occurrence can lead to several consequence events with financial losses. Finally, a branch and bound algorithm for risk response budget allocation is proposed to optimally solve project risk models.

### Results

The current status of the project has resulted in a number of computational experiments with interesting results. The results show that a three-step decision-making process can be followed to optimally allocate the response budget among risk prevention and risk protection strategies. The resource has defined some new concepts and shows that during the decision-making process, the so-called risk response requirement, the risk controllability, the relative response cost and the restrictiveness of strategies should be carefully examined.

The main results of the study are:

- There exists an optimal budget amount for project risk response, and more response budget should be planned if project managers are prudent.
- The budget allocation rules among risk causes highly depend on the logical relations between the causes and the risk, indicating a better understanding of the possible sources of project risks is helpful to achieve a proper budget allocation.

#### PhD

**Researcher:** Xin Guan

**Advisor:** Mario Vanhoucke

**Title:** Budget allocation models for project risk response

**Date:** 15/04/2021, Ghent University, Belgium

**Funding:** Chinese Scholarship Council

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# Analytical Project Control

## Taking actions under budget and resource constraints

Dynamic scheduling integrates three important phases of the project life cycle. In the scheduling phase, the baseline schedule serves as a point of reference for risk analysis and project control. Subsequently, during the risk analysis phase, the risk information of the baseline schedule is assessed. Finally, the project performance is measured and compared with the information obtained from the baseline schedule and risk analysis to initiate corrective actions.

### Research

These three phases should not be considered as independent phases, but as phases that should be conducted consecutively and iteratively. It is generally known that deviations from the project baseline schedule are inevitable during project execution (due to project delays), and therefore, the project control process is key to complete a project on time and within budget. In practice, project executions are always constrained by a limited number of renewable resources and a limited budget to restore project executions. Therefore, in this PhD, the researcher has mainly focused on the impact of resource and budget constraints on the project control process.

### Methodology

The methodology used is a combination of existing and new tools for analytical project control using Monte Carlo simulation. The analytical project control tools are developed in previous PhDs as a way to simplify the advanced statistical project control tools without losing too much quality. The project progress is imitated using simulations in which the activity durations are randomly generated from predefined probability distributions. During these simulations, corrective actions are taken to bring the project back on track, and the quality of actions is compared under different settings. The analyses done are as follows:

- Different control **budget allocation** approaches are proposed to determine the right amount of allowable budget consumption at each control phase of the project.

- Different ways of efficiently and effectively taking **corrective actions** to deliver the project on time are analysed.
- The well-known **bottom-up** project control approach is compared with the **top-down** project control approach in the presence of budget and resource constraints.

### Results

The current status of the project has resulted in a number of computational experiments with the following results:

- When resources are scarce, the existing methods for risk analysis should be used with care, and the extension to **resource/risk metrics** becomes more important.
- The timing and location of **control points** on the project is key for taking good corrective actions.

Future research projects have been defined, and plans are made to continue this fruitful collaboration between Belgium and China. Exciting new results are on their way!

#### PhD

**Researcher:** Jie Song

**Advisor:** Mario Vanhoucke

**Title:** Project control with resource and budget constraints

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# Relaxing Project Restrictions

## Adding alternative options in project schedules

The construction of a project baseline schedule often involves the selection of time/resource combinations (known as modes) for project activities that can no longer be changed easily. However, when disruptions occur during the project progress, the a-priori selected modes can result in delays and restrict the options to adapt the project schedule while maintaining the pre-specified deadline. During the project scheduling phase, full information on the best mode to include in the baseline project schedule for each activity is not available. Scheduling these projects requires decisions on which modes to incorporate in the baseline schedule to maximise the flexibility during project execution. The state of art research on multi-mode project scheduling only allows the incorporation of one mode per activity in the project schedule. When faced with uncertainty, this modelling assumption is too restrictive. In this research, multiple execution alternatives are introduced into the baseline schedule. The objective is to include as many activity alternatives as possible, in order to increase the flexibility during the project progress.

### Research

The main objective of this research is to analyse the relevance of adding multiple activity modes in the project schedule, both from a static point-of-view (scheduling phase) as from a dynamic point-of-view (during the project progress). Given the increasing interest in both the academic and professional fields for the optimal assignment of project resources and the increasing need for flexibility during project control, this research can provide a substantial contribution to both fields. In addition to devising new optimal scheduling algorithms will be embedded into a dynamic project control framework to update the current project progress when problems occur without changing the project plan dramatically.

### Methodology

The methodology of this research will be focused on the combination of exact and (meta)heuristic combinatorial optimization techniques with advanced

tools such as math-heuristics, local search optimization engines and much more. The methodology will be extended by simulation approaches and mathematical game-formulations in order to provide an integrated solution framework to optimize and control the presence of multiple alternatives for project activities.

In order to allow for benchmarking against the obtained results, the solution methodology will be applied on standardized benchmark instances, obtained from e.g. RanGen (Vanhoucke et al, 2008), MMLIB (Van Peteghem and Vanhoucke, 2014) and P2 Engine (see summary elsewhere in this book). These benchmark instances will be extended by generating a diverse set of additional parameters that include the activity alternatives used in the research.

### Results

The current status of the project has resulted in a number of computational experiments with the following results:

- Three distinct time-indexed mixed-integer programming formulations are presented and detailed computational results are provided.
- An analysis of the optimal number of execution alternatives in project schedules shows that a small increase in the number of included alternatives already results in a high degree of flexibility.
- Two of the proposed mathematical formulations yield comparable solution qualities.
- All model performances deteriorate rapidly if the deadline of the project is increased.
- More efficient solution approaches, both exact and meta-heuristic are necessary and will be developed in the near future.

#### PhD

**Researcher:** Jeroen Burgelman

**Advisor:** Mario Vanhoucke

**Title:** Scheduling and evaluating multiple execution alternatives in project planning

**Date:** 02/09/2020, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021) and National Bank of Belgium

**Email:** jeroen.burgelman@ugent.be

# Flexibility in Projects

## Increasing the degrees of freedom for facing uncertainty

The scheduling of projects, subject to resource and technological constraints in order to minimize the total project duration, is a standard problem known as the resource-constrained project scheduling problem (RCPSP). The basic problem, however, assumes that the project structure is completely known in advance. In most real-life applications, due to the ever-increasing complexity and pace of change of the environment, this assumption has been rendered obsolete. The project management community has therefore supported that flexibility is required to face the uncertainty in the project environment.

### Research

There are several approaches that incorporate flexibility during both the schedule generation (static) and execution (dynamic) phase. However, the current advanced scheduling techniques are too limited in scope to describe all the relevant types of flexibility. Moreover, dynamic techniques based on project rescheduling and disruption management are not able to provide structured approaches to include flexibility during the project generation phase. Consequently, both classes of approaches are deficient to thoroughly model flexibility in order to cope with a dynamic project environment. Therefore, this research addresses the existing research gaps by applying various types of flexibility to project scheduling in order to construct baseline schedules with a high degree of flexibility. The main objective of this research is to provide a comprehensive framework on how to include various types of flexibility in the project scheduling process.

### Methodology

The methodology of this research is based on a combination of the use of artificial and empirical project data, extended with exact and (meta)heuristic combinatorial optimization techniques and statistical simulation approaches. The incorporation of flexibility in projects will be done using different flexibility classes, which has resulted in two separate studies:

**Static flexibility:** A tabu search algorithm that selects subgraphs of a project network to minimise its project

duration is developed. This algorithm consists of two integrated phases: The subgraph selection phase, followed by the resource-constrained project scheduling phase.

**Dynamic flexibility:** During project progress, a project manager can easily switch between alternative schedules in a predefined set of schedules at different decision moments in order to bring the project back on track and avoid future uncertain events. Optimizing the construction of this set of schedules, as well as determining the best timing of these switches is analyzed in a second research study.

### Results

The current status of the project has resulted in a number of computational experiments with the following results:

- The relations between the different subgraphs in the project network, labelled as “nested” and “linked” alternatives, have a huge impact on the quality of the project schedule.
- The number of decision moments and the degree of transition when switching schedules have a major impact on the actual project duration, and this impact depends on the presence of uncertainty.
- Extensions to more complex relations between the alternative subgraphs make the problem very complex. Using logic in project scheduling results in efficient scheduling algorithms.

#### PhD

**Researcher:** Tom Servranckx

**Advisor:** Mario Vanhoucke

**Title:** Flexible network structures for resource-constrained project scheduling

**Date:** 18/05/2020, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021) and National Bank of Belgium

**Email:** [tom.servranckx@ugent.be](mailto:tom.servranckx@ugent.be)

# Setting Action Thresholds

## From statistical to analytical warning signals

Statistical Project Control (SPC) refers to the use of statistical process control charts in Project Management in order to improve the discriminative power between normal and abnormal project progress situations. Based on the existing and commonly known Earned Value Management (EVM) metrics, project control charts have been developed that have an improved ability to trigger actions when variation in a project's progress exceeds certain predefined thresholds. Despite the initial publications in this interesting research field, there is still a lot of room for extensions and improvements.

### Research

The research on SPC will not only focus on novel statistical methods for SPC to improve the quality of the thresholds, but also on ways to facilitate the use and construction of these thresholds, hereby making use of existing tools and techniques and easy-to-implement methods and rules-of-thumb. In doing so, this research aims at bringing these novel SPC methodology closer to the PM professionals, stimulating the early adoption and incorporation in the currently existing project control methodologies.

### Methodology

While there exist numerous ways to determine the optimal levels and placement of the control points and corresponding thresholds, two important methods will be used and compared. These are:

- Statistical control limits using simulation methods that determine the best performing thresholds based on artificial data.
- Analytical control limits using methods that calculate threshold levels based on static data from the baseline schedule and therefore do not require unknown input settings as is the case for the simulation methods.

Despite the ease of using simulation methods thanks to the ever increasing power of computers and the growing availability of data, it is extremely important to recognize the relevance of analytical methods. Since

these methods do not require estimates of uncertainty levels on activity durations and costs, it is conjectured that these methods are less prone to errors or biased results due to a low accuracy of the input values. The statistical tolerance limits used in SPC require an a priori state of schedule control in order to improve the accuracy of the monitoring system, which requires historical data or Monte Carlo simulations. However, the use of analytical tolerance limits are much easier to determine since they combine the ease of calculation of static tolerance limits with the improved accuracy of statistical tolerance limits, without having to make arbitrary assumptions or define an a priori state of schedule control. Further, since analytical tolerance limits only require information which is available during the scheduling phase, these limits are less complex to implement in real-life projects than statistical tolerance limits.

### Results

A computational study has been carried out to assess the performance of the proposed approach and to compare its performance with traditional buffer consumption monitoring procedures. Additionally, existing performance metrics for tolerance limits have been put into a hypothesis testing framework, and new metrics have been developed in order to fill the detected gaps in performance measurement. Results have shown that the proposed tolerance limits improve the performance of the monitoring phase, especially for parallel projects. While it has been shown that EVM/ES traditionally is much weaker for parallel networks than for serial networks, the current research shows that the use of analytical control limits can overcome this weakness, which is another big step into the continuous improvement of the accuracy of EVM/ES control systems.

#### PhD

**Researcher:** Annelies Martens

**Advisor:** Mario Vanhoucke

**Title:** Buffer management methods for project control

**Date:** 18/05/2018, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021) and National Bank of Belgium

**Email:** [annelies.martens@ugent.be](mailto:annelies.martens@ugent.be)

# Towards Big Data

## Empirical validation on real projects

For many years, both researchers and practitioners have expressed the need for a large and diverse real-life project database, based on which a wide range of project management techniques could be empirically validated and evaluated. Since the well-known DoD database (the American Department of Defense) is not accessible to foreign researchers and professionals, such a database has been created in this study, following a standardized quality-assuring approach.

The database currently consists of +100 projects from various sectors and sizes, with a large portion of them containing actual progress data, and is continuously growing.

### Research

Since project management is primarily concerned with decisions affecting the future, being able to make accurate forecasts is an essential aspect of the adequate managing of a project. Therefore, the constructed database was initially used to evaluate established and novel forecasting methods based on the proven Earned Value Management (EVM) and novel Earned Schedule (ES) concepts. Obviously, the constructed database can and will be used for many other studies in the future.

A first part of the database-driven and forecasting-related study concerns the evaluation of the most commonly used EVM/ES forecasting methods for both time and cost. The goal is to obtain reliable recommendations about which method best to use under various conditions, and to compare the obtained results with the simulated results reported in "Measuring Time".

A second part consists of the development of a novel forecasting method for both project duration and cost, which integrates the EVM/ES concepts into the exponential smoothing forecasting techniques, reference class forecasting and much more.

### Methodology

The database construction procedure was supported by the introduction and application of so-called **project cards**, a standardized tool for project data

categorization, evaluation and acquisition. A project card provides information about a project's characteristics regarding baseline schedule, activity risk and project control. Based on these project cards, the quality of a project's baseline data and tracking data can be assessed, as well as gaps in the initial database (regarding sector, size, authenticity, etc.) can be identified and then filled via a targeted search for appropriate data.

### Results

The project cards provide a helpful tool for qualitative database construction as well as for testing the accuracy and quality of EVM and ES methods.

- EVM is just as effective for forecasting project duration as for forecasting project cost.
- The Earned Schedule method is clearly more accurate for forecasting project duration than the Planned Value method and the Earned Duration method.
- Project regularity has an influence on both time and cost forecasting accuracy, while project seriality only influences time forecasting accuracy.
- The unweighted forecasting methods (i.e. the performance factor is set to 1 to express that the future performance is assumed to be as planned) perform best for both time and cost forecasting.
- Reference class forecasting techniques and exponential smoothing analyses can significantly improve the accuracy of time and cost predictions for projects.

#### PhD

**Researcher:** Jordy Batselier

**Advisor:** Mario Vanhoucke

**Title:** Empirical evaluation of existing and novel approaches for project forecasting and control

**Date:** 02/09/2016, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021) and National Bank of Belgium

# Project Contracting

## A prescriptive analysis of incentive contracts for project management

Incentive contracts are often used in project management to align the conflicting objectives of project owners and the contractors they employ to execute (parts of) a project. Whereas project owners have great interest in the outcome of the project with respect to duration, cost and scope, the contractor often remains solely interested in his short term profit.

Especially when contracts are linked to multiple performance dimensions, optimizing the design and execution of such contracts becomes nontrivial. While the project owner is mainly interested in maximizing the utility derived from the project's outcome, the contractor's main concern is to optimize the inherent risks and trade-offs encountered in the specific project contract.

### Research

This research study aims to unify the largely qualitative body of literature on contract design with more quantitative research from the area of project management. This is done through the creation of novel quantitative models which are able to accurately describe incentive contract structures as well as relevant project properties. These models allow the use of advanced optimization methods from other research domains such as project scheduling and control.

### Methodology

Both artificial data from literature as well as empirical data collected from international companies are used to represent a wide range of possible incentive contracting situations. Using quantitative optimization methods, prescriptive statements can be made on the optimal way of managing these specific situations. Moreover, through the development of a project classification scheme, more general notions on the management of incentivized contracts are derived. A multiple-objective scatter search method has been presented to quickly analyse and compare contracts for different projects. Moreover, an earned-incentive project control system, similar to a traditional earned

value management system, has been presented, which is completely new in the academic literature.

### Results

This research aims to provide prescriptive insights on the impact of incentive contracts for the different areas of project management:

- How should contracts be designed at a strategic level?
- How can incentivized projects be scheduled in order to maximize profit?
- Which techniques can be designed to improve the controlling of incentivized projects?

The research presents guidelines to design a project contract and provides answers on the question above. Moreover, the research has also shown that the earned-incentive control system is able to control the incentives negotiated between contractors and owners of the project, and therefore, can be considered as a valuable extension of the earned value methodology.

#### PhD

**Researcher:** Louis-Philippe Kerkhove

**Advisor:** Mario Vanhoucke

**Title:** Improving decision making for incentivised and weather-sensitive projects

**Date:** 09/09/2016, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021), Fonds voor wetenschappelijk onderzoek (GO15711N) and National Bank of Belgium

# Constructing Schedules

## Optimizing cash flows

Optimizing the Net Present Value (NPV) of a project is a research topic that finds its roots in a paper written in 1970. Rather than focusing solely on the project duration minimization, the inclusion of the time value of money using the NPV concept leads to better and more realistic schedules. A project's NPV however depends on the timing and amount of payments, and hence on the timing of the baseline schedule. In literature, a number of payment models exist ranging from payments occurring once an activity has been completed, to payments at predetermined points in time. Depending on the selected payment model, different schedules lead to different NPVs. Consequently, each payment model requires a different baseline schedule to fully optimize the project's NPV.

### Research

Resource-constrained project scheduling with discounted cash flows is a topic that has been investigated since decades. In the new research, activity cash flows are optimized from the point of view of the contractor. The goal is to design an appropriate meta-heuristic, and compare existing payment models. The proposed algorithm will have operators (e.g. local search) fine-tuned for each payment pattern to clearly demonstrate the differences between the models, and their influence on the resulting schedules.

The different payment models are applied in the context of resource constrained project scheduling optimization, in specific with the inclusion of multiple execution modes for each activity. Each mode requires a different combination of resources and leads to a different activity duration. The point of including modes is to increase flexibility so each activity can be executed in a (limited) number of ways. Typically shorter modes lead to a higher resource demand whereas longer ones require fewer resources. This way a trade-off has to be made between the different modes of an activity in order to maximize the project's NPV.

### Methodology

The employed methodology focuses on integrating the NPV maximization objective with the multi-mode trade-off. A genetic algorithm (GA) is used as method to further improve generated project schedules by

combining them to construct better solutions. A GA is one of several well-known evolutionary algorithms based on organic evolution, and makes use of crossover operators to combine several existing schedules, mutation to change a single schedule, and selection to determine what schedules are maintained.

### Results

Based on a comparison of payment models using the meta-heuristic search procedures, the following results are obtained:

- The payment model has a strong influence on the timing of the baseline schedule.
- The optimal selection of activity duration/resource combinations depends on the payment model.
- The methodology can be used for extensions to multi project settings and resource investment problems.
- Adding payment models to time/cost optimization can further increase the realism of cash flow optimization models for project scheduling.

#### PhD

**Researcher:** Pieter Leyman

**Advisor:** Mario Vanhoucke

**Title:** Heuristic algorithms for payment models in project scheduling

**Date:** 16/09/2016, Ghent University, Belgium

**Funding:** Bijzonder onderzoeksfonds (BOF12 GOA021), Fonds voor wetenschappelijk onderzoek (GO15711N) and National Bank of Belgium

# Business Games

## No teaching without research

Training and teaching should be an integrated approach, and any training session on Project Management (PM) should ideally be supported by a strong and quantitative research background. The Project Scheduling Game is such a training game in which students are responsible for time/cost decisions for activities of projects in progress to assure that they finish on time and within the specified budget. As uncertain and unexpected events lead to unwanted effects on the expected performance, corrective actions need to be taken to carefully control projects to bring them back on track.

### Research

The study is based on data gathered from PM courses at universities and business schools in Belgium, France and the UK. Each training session is followed by a feedback session in which the various approaches taken by the students are discussed and analyzed. In order to give a substantiated feedback, these discussions are better supported by research results, which is our main motivation for carrying out this student experiment study. In the experiments, a classification of the student behavior is made based on the collected data throughout the years. The classification is crucial to investigate the impact of the different approaches taken by the students on the outcome of the game. Focus, criticality, ranking, intensity and action constitute the five dimensions which make up a certain class of exhibited behavior during the game. In order to establish a link between the classification and the overall game outcome, a rigorous computer experiment is set up.

### Methodology

Data is collected from students by automatically logging all actions taken by the students in the software tool. This database consisting of more than 10 years of data is then analyzed and classified using statistical software. A computerized experiment is set up to simulate human behavior based on this classification of real data to test the impact of different approaches taken by students on the overall quality of the final game outcome [i.e. the time/cost/risk performance]. A comparison and benchmark with an optimal solution approach found by a computerized

branch-and-bound algorithm allows us to measure the impact of the project characteristics, the degree of uncertainty, and the time/cost profiles on the best approach taken by students.

### Results

The experiments are set up to measure the impact of:

- A risk-based approach on the final delay of the project.
- A time-based approach on the ability to reach the final client deadline.
- A cost-based approach on the ability to finish the project within the predefined budget.

#### PhD

**Researcher:** Mathieu Wauters

**Advisor:** Mario Vanhoucke

**Title:** Time/cost optimization and forecasting in project scheduling and control

**Date:** 18/09/2015, Ghent University, Belgium

**Funding:** Fonds voor wetenschappelijk onderzoek (G/0095.10N)

# Statistical Project Control

## An overwhelming deluge of data

Project control systems must indicate the direction of change in preliminary planning variables compared with actual performance. In case the project performance of projects in progress deviates from the expected planned performance, a warning must be indicated by the control system as a trigger to take corrective actions. Earned Value Management (EVM) and Earned Schedule (ES) are systems that enable the project manager to quickly assess the health of a project, and serve as a warning mechanism to trigger corrective actions in case the project is in danger. While the relevance of EVM/ES is recognized in both the academic and professional world, this research project has embedded this methodology into a statistical research framework.

### Research

A new Statistical Project Control (SPC) approach based on the principle of statistical process control charts is presented in order to improve the discriminative power between normal and abnormal project progress situations. Based on the existing and commonly known EVM/ES metrics, the project control charts will have an improved ability to trigger actions when variation in a project's progress exceeds certain predefined thresholds. Statistical control limits using tolerance limits and multi-variate analysis have been developed to improve the reliability of the control decision making process. By minimizing the effort of control and the probability of false warning signals, the efficiency of these methods should enable to project manager to improve their accuracy of control.

### Methodology

A large number of simulation experiments has been set up using P2 Engine running on Ghent University's super computer infrastructure, leading to gigabytes of data in order to test the ability of the statistical project control charts to discriminate between random and assignable variation. An intensive analysis of the generated data is done to compare the use of statistical project control limits with traditional earned value management thresholds and to validate their power to report warning signals when projects run into danger.

Moreover, a method to analyse real project data and to transform them to an artificial setting using a sound and proven methodology is tested on a set of 12 real projects. This enables the researchers to setup simulation studies that better reflect the real-life requirements of project managers. It also improves the realism of simulation studies performed in the academic world.

### Results

The results of the computational experiments show that:

- The use of SPC outperforms the best practices in EVM.
- The Earned Schedule (ES) approach performs better than the traditional EVM approach.
- A combined use of X-charts and XR-charts allows to detect a variety of project problems.
- An extended multi-variate analysis control approach leads to control efficiency improvements.
- Statistical based control limits outperform the simple rules-of-thumb used by project managers, without increasing the effort of control.
- The newly developed statistical methods outperforms the currently known statistical project control methods presented in literature.

#### PhD

**Researcher:** Jeroen Colin

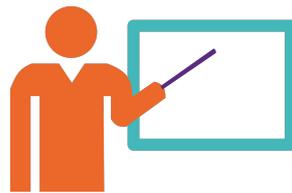
**Advisor:** Mario Vanhoucke

**Title:** Single and multi-variate methods for statistical project control using earned value management

**Date:** 17/04/2015, Ghent University, Belgium

**Funding:** Faculty of Economics and Business Administration

# Education



# Project Management Education

**“The whole purpose of education is to turn mirrors into windows.” - Sydney J. Harris**



The Project Scheduling Business Game at a Project Management course for Master students at Ghent University

## Why we teach

As an academic, one of the best and most effective ways to share the existing PM knowledge and to tighten the gap between research and practice is to create awareness and share new concepts with the youngest and probably most interesting group of potential project managers: the students. Teaching Project Management to students at the university and business school is one of the main outlets of our research activities and collaborative projects. When searching for a definition that clearly captures why people teach, I came to several often very different descriptions. One of these definitions was simple and to the point and probably captures the essence of teaching: “Teaching is concerned with the activities which are concerned with the guidance or direction of the learning of others.”

Further defining all facets of the purpose of teaching is probably a task that must be done by academics, pedagogics, academic institutions, and by many more people involved. I have therefore no ambition to add my

own definition of teaching in this book. I will only use my (maybe limited) experience to share my opinion on teaching and show how I try hard to bring that opinion alive in my classes. The best way and hence the exact definition of teaching is obviously influenced by the political and social backgrounds of the country and the student group. In my classes in Belgium, the UK and China, I use a very different approach to bring the same message to my students. But I believe that despite these differences, a teacher should have one single goal in mind ... get them involved.

## Teaching today

In the last few years, many sources have claimed that education has changed dramatically with the launch of new technologies (internet, tablets, online resources, ...), the availability of interactive ebooks, the ability for online learning, and much more. Rather than solely focusing on a transfer of knowledge, teaching should now primarily stimulate a new way of critical thinking. While many believe that the new technologies will facilitate the critical thinking, many others stick to the traditional way of knowledge sharing as the best approach.

The truth about the real purpose of teaching probably lies somewhere in the middle and should contain a mix of all of this. It should use new technologies in some cases and rely on traditional methods in others. It probably should contain a well-balanced mix between knowledge transfer and critical thinking evaluation. However, despite new technologies and various often conflicting views on teaching, I believe any teacher should have one common goal in mind. Teaching is trying to reach the people who often are very interested in the topics but have little or no experience in the newly presented topics. Therefore, I believe that the best way to reach these people is to get them involved. I try to avoid working on an island but instead I want to show them, in an active way, what I can do together with them.

## Get involved

In one of the online articles of PM Knowledge Center, the students are asked to step outside their student environment and set their first steps in their professional career by getting involved. To that purpose, we take various initiatives, summarized in the ‘education’ chapter of this book. I hope it will be

interesting for all students following a Project Management course, and any teacher in Project Management. I also hope that all the material that we use helps both students and teachers in getting them involved. The online learning tools, the books and articles, the excellent support from assistants, the ability to get involved in PM events to stimulate interaction with professions, the software tools and business games used in class and the case studies and exercises should allow the students to get involved in the field of PM.

I hope that all of this material inspires some of the students such that they - hopefully - believe that being a Project Manager is the most interesting job in the world.

# Blended Learning

## Enhancing student learning and engagement

**“It is the supreme art of the teacher to awaken joy in creative expression and knowledge.” - Albert Einstein**

Education in its general sense is a form of learning in which the knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching, training, or research (WikiPedia). The education provided at universities and business schools is a way of academic learning to transfer knowledge of different kinds to students by classic teaching methods, such as group lectures, discussions or case study assignments, but also by working independently, in small groups, and in large groups, using simulation tools or e-learning platforms, and much more.

### Blended learning

Throughout the past decade, both the teaching method and content for Project Management education has been built up, adapted and fine-tuned to be used in a flexible and dynamic teaching environment rather than in a traditional ex cathedra teaching method.

The style and methods of teaching can probably be best described as **blended learning**, which is not so much an innovation in teaching but more a by-product of the digital techniques available in the classroom. It is an ideal way to design courses that mix different kinds of teaching methods and supportive material to engage students and bring them closer to the relevance of the course content, hereby stimulating engagement, involvement and even enthusiasm resulting in a better learning experience.

### Overview

The figure on this page is made for PM instructors, professionals as well as students to show what kind of mix in PM tools, techniques, case studies and other study material can be combined to improve the PM knowledge. It gives an overview of the PM course development throughout the years, from its initial start of the course till today (spring 2014), and consists of 7 aspects displayed on the left of the picture. Further details can be found elsewhere in this book.

**Software tools:** The use of MS Project and ProTrack to stimulate learning by doing as well as the fast P2 Engine as a research tool have enhanced student participation (See article: ProTrack: Dynamic scheduling on your desktop)

**Business games:** The Project Scheduling Game (PSG) and its extension (PSG Extended) lead to better project control skills (See article: The Project Scheduling Game: Project Management skills that you will never forget)

**Online learning:** Online learning via the PM Knowledge Center (PMKC) (See article: PM Knowledge Center: Step inside - Knowledge freely available!)

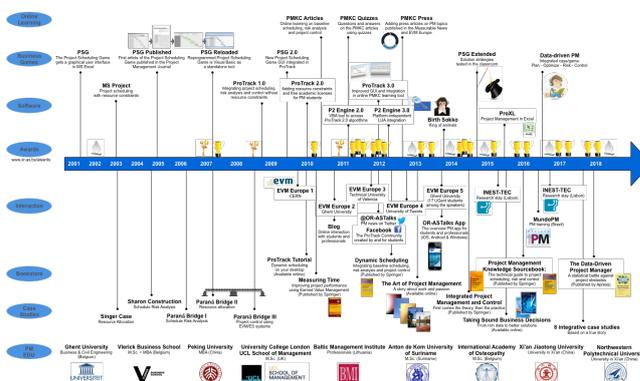
**Bookstore:** An integrative set of five books to provide students with content, underlying research and further methodological details (See article: Bookstore: Written communication with a targeted audience)

**Case studies:** Combining active participation and practical relevance using more than 5 PM case studies (See article: Project Management case studies: A student should be an active participant, not a passive consumer)

**Interaction:** Stimulating interaction between students and professionals in various ways (blogs, apps, workshops) to stimulate engagement, enthusiasm and involvement (See article: ORASTalks App: Share and get involved)

**Awards:** Award the work of students, researchers and teachers to invoke enthusiasm (See article: PMI Belgium’s University Contest: Praise youth and it will prosper)

**PM EDU:** Overview of the PM teaching sessions given at various universities and business schools



Overview picture of blended PM teaching material developed in the last decade at Ghent University (see next page for full picture)



# @Vlerick Business School

## Project Management in line with your strategy

**“By choosing a project-based approach, you essentially opt for a different working method.” - Vlerick Business School**

Project-based working radically differs from other work methods. Just like its opposites of routine work and improvising, project management has its specific characteristics and challenges of its own. These days, project management is no longer solely considered as a set of planning techniques. Focus is shifting toward other aspects such as the integration with risk management and control, coaching and directing project teams and optimal structuring of projects. This program offers a clear focus on the business practice and guarantees a positive impact on your projects.

### Why this program?

The Project Management program of Vlerick Business School is a 4 days training in English or Dutch aiming at giving a full overview of the important topics that make Project Management so challenging.

- You will know how to design, plan, and manage projects
- You will understand the drivers of project performance
- You will recognize the challenges and pitfalls of every project phase
- You will be able to prevent potential problems through network planning
- You will know how to keep your projects aligned with company strategy and allocated resources
- You will apply Earned Value Management successfully
- You will be comfortable directing and managing project teams

### For whom?

This program targets current project managers and would-be project managers. As well as all managers who need to understand project management fundamentals.

- Professionals and managers working in or with project organizations who are keen to get a firmer grip on the set-up and execution of projects
- Individual contributors that need to understand project management fundamentals

- Future project leaders that need to make well-informed decisions of projects in progress by monitoring their performance and predicting their final expected timing and costs
- Managers and directors that wish to introduce project management into their organizations will certainly find benefit in this program as well

In previous editions, we had the pleasure of welcoming participants from companies like: DJ Services, Janssen Pharmaceutica, Det Norske Veritas, Cobi Consulting, Pfizer Manufacturing Belgium, Ziekenhuis Oost-Limburg, Programmatorische Overheidsdienst Wetenschapsbeleid, KBC Securities, Fluxys, Soneva, Eval Europe, Vitalo Industries, Bayer, Videohouse, Waterwegen en Zeekanaal, Brico, TML, Vlaams Agentschap voor Personen met een Handicap, Fabricom, Saatchi & Saatchi, Vlaams Instituut voor de Logistiek, Nationale Loterij, Algist Bruggeman, Kiwa Belgium, Compuware, Genzyme, Vitalo Industries, Etex Engineering, Het Excalibur Genootschap, Coralius, KBC Securities, Vanbreda International, AXA and many others.

This program has been followed by Business analyst, Projects officer, Interim manager, Communications manager, Project coordinator, Category manager, Account manager, Expert supply chain organization, Trade marketing manager, QA manager, Manager finance, Head of external communication, Enablement manager, Product specialist, Project manager, Project engineer, Managing director, Consultant, ...



Brochure Project Management  
([www.vlerick.com/projectmanagement](http://www.vlerick.com/projectmanagement))

## Lecturers

The introduction session is given by:

**Tom Jacobs:** Tom aims at management training with the combination of hard (technical) and soft (social) skills as a particular added value, with a focus on Project and Time Management.

The following faculty members will take care of the remaining sessions in the Project Management program:

**Mario Vanhoucke:** Mario is passionate about everything that is related to project scheduling, risk analysis and project control. He is continuously searching for better ways to measure, improve and optimize the performance of projects in progress and their resource efficiency.

**Dirk Buyens:** Dirk is the authority on strategic HR and can bring out the best in you and your organization when it comes to the field of people management, career management and organization development.

**Antonio Nieto-Rodriguez:** Antonio is director of the program management office at GlaxoSmithKline. He is a lecturer in project management at Vlerick as well as professor at Duke CE and Instituto de Empresa.



**Book**

**Base**

- What is ... Baseline Scheduling? (a two-pages summary folder)
- Download the article "Project baseline scheduling: An overview of past experiences" published in the Journal of Modern Project Management
- Book "Project Management with Dynamic Scheduling: Baseline scheduling, risk analysis and project control" published by Springer

**Schedule Risk Analysis**

- What is ... Schedule Risk Analysis? (a two-pages summary folder)
- Download the article "On the use of Schedule Risk Analysis for Project Management" published in the Journal of Modern Project Management
- Read the book "Integrated Project Management and Control: First comes the theory, then the practice" published by Springer

**Project Control**

- What is ... Project Control? (a two-pages summary folder)
- Download the article "Measuring the efficiency of project control using fictitious and empirical project data" published in the International Journal of Project Management
- Book "Measuring Time: Improving project performance using Earned Value Management" published by Springer

**Work and Passion**

- Download the free book "The Art of Project Management: A story about work and passion" published by OR-AS

**App Store**

**ORASTalks**

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# Data-driven Project Management

## Plan. Game. Risk. Control.

**“It does not take much strength to do things, but it requires a great deal of strength to decide what to do.” - Elbert Hubbard**

After all these years of teaching at different universities and business schools, I realize that students might have totally different expectations of a lecture on managing projects. Some expect an overview of soft skills necessary to cope with the conflicting demands of people in a team, while others prefer a collection of tools and methodologies that might be beneficial for the projects. Whatever their desire, students do not expect an overview of highly theoretical principles, but rather a practical training on how to use the quantitative methods to uplift their skills on data-driven project management.

### A statistical battle against project obstacles

The course module “Data-driven Project Management” is a highly interactive and practical course module focusing on the integration of planning, risk and control. It is based on a series of case studies taken from the latest book “The data-driven project manager: A statistical battle against project obstacles”, a business novel about integrated project management and control. The training enables students to get acquainted with the quantitative project management concepts using an integrative four-phased case study.

The training is based on practical experience as well as academic research published in various academic

books published by Springer ([www.or-as.be/bookstore](http://www.or-as.be/bookstore)). The case study aims at delivering the required technical skills to manage large and complex projects, but also tests the students’ performance under time pressure, their critical mindset, as well as communication skills and quality of written analyses.

The 2.5-days training makes use of an integrated case study, combining practical assignments with a mix of lectures and feedback sessions. Students are expected to solve the case study in four sequential phases in a team. A short written analysis of each part of the case must be submitted to the lecturer which serves as material for the final evaluation. The case study has been made in collaboration with PMI Belgium (cf. article “PMI Belgium’s University Contest: Praise youth and it will prosper”).

During the four case studies, students have to analyze the settings of their project, and finally made a decision and proposal to continue. The four parts of the case study entitled “plan”, “game”, “risk” and “control” are summarized along the following lines. In order to give the case studies an international dimension, they describe various international projects around the globe (from South-America to China and Australia) and vary from a drone development project, a satellite construction project, a health-care optimization project, an offshore wind turbine project, etc. (cf. picture on this page).

### Plan

The construction of a project plan requires a detailed network analysis consisting of activities and relations between activities and the use of scheduling

	<b>GreenPlanet</b> Automated Drone Development Project
	<b>RoadConnect</b> Bridge Construction Project
	<b>SeaPower</b> Offshore Wind Turbine Project
	<b>SmartNet</b> Cite-wide Internet of Things Network Project

	<b>SolarSpace</b> Solar Powered Satellite Project
	<b>GlobalConstruct</b> Tennis Stadium Construction Project
	<b>HolyHeart</b> Kid Friendly MRI Project
	<b>E-Learning</b> Redesign of E-campus Platform Project

The 8 versions of the case study, each time using a different project description

techniques such as the PERT/CPM method. Concepts such as the critical path, activity slack, activity crashing, resource allocation, and other scheduling techniques are discussed.

### Play

The techniques and concepts discussed in the morning session are now used in a computerized exercise published in the Project Management Journal. The computer exercise consists of an introduction, a 90 to 120-minutes game session where the students have to analyze the current project performance, analyze alternatives and finally take decisions at each decision moment.

### Risk

Large projects are typified by uncertainty and unexpected events, which might bring the project objectives in danger. Prior knowledge about the expected impact of uncertain events is key for the project's success. Schedule Risk Analysis is such a technique that reviews the constructed schedule in the light of uncertainty. An overview of the risk analysis techniques and their use in practice is given, and students need to analyze the risk metrics for their project prior to and during its execution.

### Control

Controlling projects is key to the success of a project since it enables the project manager to measure the performance of the project in progress and gives early warnings as triggers for corrective actions. An introduction to Earned Value Management and Earned Schedule control techniques is given, and the students have to apply and interpret these techniques in both a single project and a project portfolio setting.

### Wrap-up

The concept of control efficiency will be discussed in this session, aiming at integrating the previously discussed concepts. Moreover, a wrap-up of the main lessons learned will be given and the training will be concluded with a small PM knowledge test.



Same as picture below, 2 years later  
(December 19, 2018)



Picture taken after the 2.5 days Project Management case study sessions  
in the Master in International Management and Strategy (MIMS) at Vlerick Business School  
(December 22, 2016, ready for the Christmas break)

# Software in the classroom

## Improving decisions using tools

**“If something is worth doing once, it’s worth building a tool to do it.” - Author unknown**

ProTrack 3.0 is a complete redesigned version of the smart version of ProTrack 2.0 to make it the ideal tool for use in the classroom. Its integration with PM Knowledge Center, its extension to the Project Scheduling Game, the availability of case studies and its strong focus on the integration of baseline scheduling, risk analysis and project control make it yet a stronger learning tool to stimulate interaction between researchers, students and practitioners in the field of project management and dynamic scheduling.

### Learning features

- PM Knowledge Center: Automatic access to the knowledge shelf of PM Knowledge Center is integrated in the opening screen of ProTrack.
- Games: The Project Scheduling Game is since 2009 fully integrated in ProTrack and therefore relies on a same layout and approach.
- Case studies: Evaluating a complex project scheduling proposal and suggesting a schedule to your project team using case studies requires the use of ProTrack.
- Dynamic scheduling: The Project Management course at Ghent University puts, just like ProTrack, a strong focus on the integration between scheduling, risk and control.

### At Ghent University

Currently, ProTrack is used in the classroom at Ghent University (Belgium) for two purposes:

- Group works: Part of the evaluation of the PM course at Ghent University consists of a group work where students have the maximum freedom. Their task consists of analyzing PM tools, techniques, situations, project data, company methods, etc. and ProTrack is often used to analyze the project data.
- Master theses: During their master thesis, students have to analyze an innovative research question through a 2-years research study. ProTrack allows them to easily generate and analyze project data.

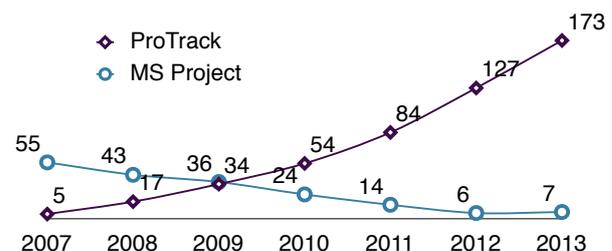
Throughout the work, all students are free to use any software they want, but the free availability of academic versions of our ProTrack tool and its deep integration with the course content of PM have led to shift from MS Project users to ProTrack.

### Innovative ideas

The use of ProTrack by students is more than giving them a PM tool for their project work. One of the most important advantages of putting ProTrack available for academic use is that students use the software tool in the most critical and innovative way. They often have very good suggestions for extensions, or even build their own extensions on top of our beautiful tool (in MS Excel or C++ or any other tool). They even have created their own ProTrack Facebook group, which is accessible via:

[www.facebook.com/groups/theprotrackcommunity](http://www.facebook.com/groups/theprotrackcommunity).

The students often don't realize it, but they are our main innovators. Thank you!



Number of students using ProTrack or MS Project at Ghent University (2007 - 2013)

(After 2013, ProTrack has been put on the central university server and individual use is therefore no longer monitored)

# Project Management case studies

## Learning by doing (Part I)

“A student should be an active participant, not a passive consumer.”

- Bell Hooks

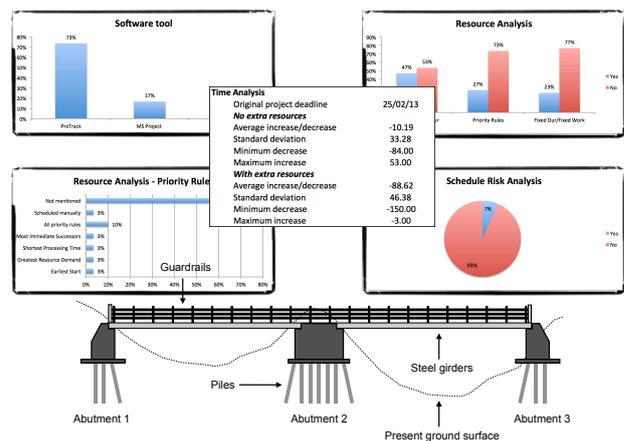
### Develop Project Management skills

Developing skills by discussing complex scenarios in an interactive way stimulates critical thinking and creativity and makes the student an active participant, rather than solely a passive consumer of the course material. To that purpose, three integrative case studies have been developed by the OR-AS team at Ghent University, focusing on three different aspects of project management. These Mutum-Paraná II Bridge project case studies are a series of three integrative exercises to get acquainted with the complexity of dynamic scheduling using fictitious project data.

- The Mutum-Paraná II Bridge project (A) case study puts a clear and strong focus on the integration of baseline scheduling and schedule risk analysis.
- The primary goal of the Mutum-Paraná II Bridge project (B) case study is to get acquainted with project scheduling software and to construct a feasible resource-constrained project schedule. Students must analyze a project proposal using ProTrack and present their results in a written report.
- In the Mutum-Paraná II Bridge project (C) case study, students get acquainted with the Earned Value Management approach to control projects. Students analyze the data of three projects in progress and present their results to the management committee.

### Teaching approach

The choice of the teaching method to be used depends largely on the content of the case study, the background of the students, the size of the groups, and it may also be influenced by the attitude and enthusiasm of the students. The Mutum-Paraná II Bridge project case studies are solved as group exercises to stimulate discussion among the group members aiming at a written report, or as individual class exercises immediately followed by a feedback session.



### Feedback

Individual class exercises are followed by a short feedback session at the end of the exercise, while feedback on written group exercises is given via an overview report analyzing and evaluating the main findings of the students and reporting the main lessons to learn via Twitter [@ORASTalks](#).



OR-AS Talks @ORASTalks  
134 students working with project scheduling software at Ghent university! [or-as.be/blog/project\\_s...](http://or-as.be/blog/project_s...)  
Expand

20 Nov

### Why Paraná?

Good question! A purely accidental choice. Maybe because I was intrigued by the Brazilian way of living? Or maybe it was far enough from where I live to be special. In any case, in another article in this book (cf. “MundoPM: Project management trainings in Brazil”) you will read that I have visited the Paraná river in Brazil more than 10 years after writing these case studies, and I didn’t regret it at all. Life’s strange. Life’s good.

# Project Management case studies

## Learning by doing (Part II)

**“It's not enough to be up to date, you have to be up to tomorrow.” - David Ben-Gurion**

### New case studies (2021)

In the previous article, I discussed my favourite case studies about the bridge construction projects that I used for many years in my lectures. In 2021, in the middle of the COVID-19 crisis, I thought it was time for an update. I wrote 4 new case studies as described below.

#### COVID-19: How long will a vaccine really take?

Topic: Project planning with PERT/CPM

Authors: Mario Vanhoucke and Tom Servranckx

**Abstract:** Many European countries were heavily impacted by the COVID-19 pandemic outbreak and their governments initially focused on limiting the spread of the virus. In the headquarters of the European Health Organisation (EHO), responsible for coordinating the European policy during health crises, the focus shifted from a short-term containment strategy to a long-term solution strategy: the development of a COVID-19 vaccine.

#### The hydrogen energy North Sea project

Topic: Schedule Risk Analysis

Authors: Mario Vanhoucke and Tom Servranckx

**Abstract:** The joint venture of the Belgian companies NorthConstruct, a construction company, and HydroEnergy, an energy company, has won the bid for a new innovative and challenging project. They will construct an artificial island in the North Sea, in front of the Belgian coastline, to produce hydrogen energy using the nearby offshore wind parks and, subsequently, transmitting this energy to the mainland.

#### The FastTube Transportation Technology Project

Topic: Critical Chain and Buffer Management (CC/BM)

Authors: Mario Vanhoucke and Tom Servranckx

**Abstract:** The province of South-Holland in the Netherlands is suffering from severe traffic congestion problems, resulting in huge time losses, reduced economic activity and increased air pollution. In recent years, the number, length and frequency of the traffic jams in the province had increased drastically and this could be attributed to the increased economic activity

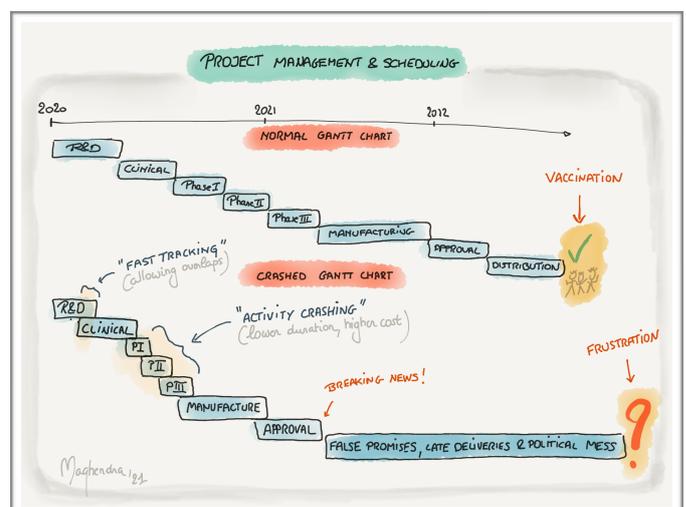
of its harbour in the city Rotterdam. Reducing the capacity of the harbour is not an option due to its importance for the past and future economic growth and wealth in the region. Instead, the council formulated the ambition to significantly reduce the number of cargo transportations via trucks from and towards the harbour in order to limit the traffic over medium-range distances. Therefore, a dense system of tubes would be installed throughout the province in which capsules, each the size of a medium-sized truck, would be transported using pressured air and magnetic accelerators.

#### The mangrove rehabilitation project

Topic: Earned Value/Schedule Management

Authors: Mario Vanhoucke and Louis-Philippe Kerkhove

**Abstract:** Climate change and rising sea levels in recent years have increased the speed of erosion of the Surinamese coastline. This is due to the fact that the coastline of Suriname consists mostly of muddy banks, which are very susceptible to erosion. A traditional way of battling this erosion is by the construction of seawalls. However, this approach is very costly and is therefore only feasible in very specific places, such as important roads or towns. In order to counteract erosion along the remainder of the coastline, the Surinamese government has launched a rehabilitation project where mangrove forests are replanted in order to reinforce the coastlines.



After my case study lectures, I show this COVID-19 cartoon to my students

[www.linkedin.com/feed/update/urn:li:activity:6776419895237218304/](https://www.linkedin.com/feed/update/urn:li:activity:6776419895237218304/)

# PM Knowledge Center

## Stimulating communication and getting involved

**“Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it.” - Samuel Johnson**

The quote "Knowledge is of two kinds. We know a subject ourselves, or we know where we can find information upon it" by Samuel Johnson has inspired OR-AS to create an online system to assure that students of Project Management courses at Ghent University, Vlerick Business School and University College London have the knowledge where to find information on it.

### PMKC use

PM Knowledge Center (PMKC) is used as a supportive online learning tool at Project Management (PM) courses at Ghent University (Business Engineering and Civil Engineering) and University College London (UK). It is considered as a centralized knowledge shelf containing additional background articles or further detailed explanations on topics discussed in the classroom. It should allow any lecturer to give a broader overview of Project Management and leave the details to the interesting students who visit PMKC.

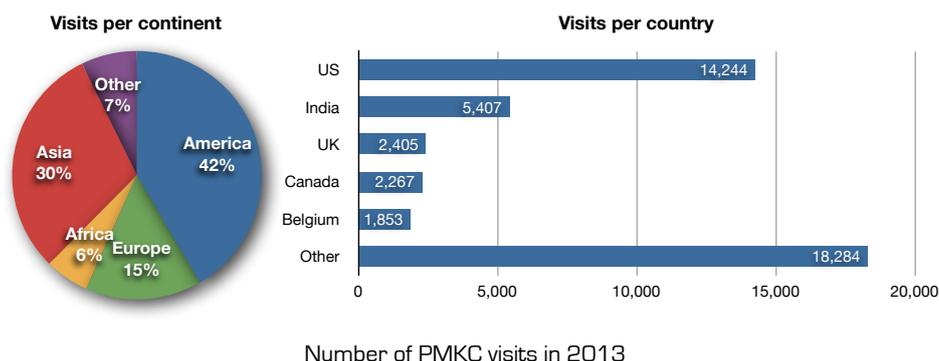
The online learning tool is also used in other courses at Vlerick Business School (Belgium), in MBA training sessions at Beijing University (China) and even in a master at Anton de Kom University (Suriname). Even though non PM related topics are often discussed in these courses, with a main focus on decision making tools for business, it lowers the threshold for both the instructor and the students to use relevant examples from Project Management.

On top of that, PMKC is also a centralized knowledge shift for many other trainers, teachers, students and possible professionals, since the majority of the PMKC website visits come from other regions than the ones where I am actively involved during my teaching sessions. In 2012, one year after its introduction, PMKC had over 10,000 visits and the various articles had been downloaded more than 23,500 times. These numbers grew in 2013 to 44,460 and 79,000, respectively.

### PMKC benefits

The benefits of PM Knowledge Center are wide and diverse and will hopefully grow along the expansion and development of PMKC. Currently, the added value of PMKC for my teaching courses can be summarized in these three bullets:

- Online learning: Thanks to the use of an easy-to-access tool with articles that perfectly fit into the course content, it allowed me to jump on the recent trends of online learning and sharing information through online channels such as website, blogs, tablet apps and even twitter. It makes the PM course content accessible in many ways, and even for topics that I only briefly touch in the classroom, the step to go deeper is easy to take. Nice to know is that since the introduction of PMKC in the classroom, the quality of the group assignments went up drastically, resulting in very interesting written reports by students and winning the PMI Belgium prize as discussed elsewhere in this book!
- Interaction stimulation: Actively engaging students during a course can be more challenging in large classes than in small classes. Unlike MBA courses that are typically given in smaller groups on the basis of class discussions and active participation,

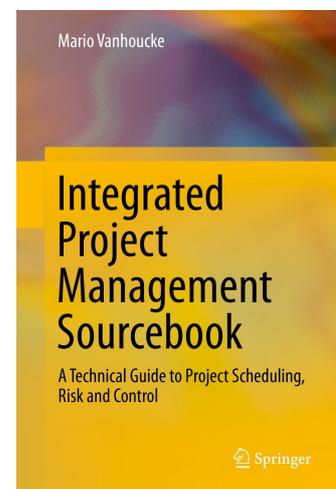


university courses are held in big classrooms to groups with hundreds of people. Stimulating interaction by reducing the distance between the instructor and the student, using the PMKC quizzes or the possibility to interact online is a first step towards a more communicative direction. I believe it only shows the tip of the iceberg and much more can (and will) be done.

- Getting involved in other organizations: One of the main drivers to use PMKC in the classroom is that it allows students to get involved in our PM activities. Therefore, PMKC can be seen as a warm welcome to the students to step outside their safe academic student environment and to make their first careful steps into their professional career by getting involved. At PMKC, we have published a summary of a number of projects and results that we have obtained in collaboration with other organizations, either as sponsors, clients or collaborative partners. Just like the booklet that you have in front of you, one of the main reasons why PMKC exists is to link the PM courses to the outside world and to inspire the students to make that step.

### Beyond PMKC

While PM Knowledge Center is still the open and freely available online learning tool for students of my course modules, I assembled all articles in a book and extended them with questions and answers. The book "Integrated project management sourcebook: A technical guide to project scheduling, risk and control" is available for sale at the Springer website, and solutions to the questions can be downloaded from [www.or-as.be/books/pmkc](http://www.or-as.be/books/pmkc).



PM Knowledge Center extended with exercises and solutions, entitled "Integrated project management sourcebook: A technical guide to project scheduling, risk and control"

# Experiments in the classroom (Part I)

## Communication in business games

**“Business is a game, played for fantastic stakes, and you're in competition with experts. If you want to win, you have to learn to be a master of the game.” - Sidney Sheldon**

Business simulation games are used as educational tools for teaching business at universities, business schools and executive teaching. These often computerized games aim at training of players in business skills as well as evaluating the players' performances. The use of these games often stimulate student participation and interaction, leading to a better engagement and improved satisfaction.

The Project Scheduling Game (PSG) and its extended version (PSG Extended) are two business games used in the Project Management modules of universities and business schools curricula. They both require actions from students who are responsible for complex projects in a dynamic and uncertain world generated by a computer algorithm. Details of these games are discussed elsewhere in this book.

### Not only teaching

A nice side effect of business games and student participation is that they can also be used for research experiments. Indeed, the classroom is a virtual reality setting in which students make decisions in a controlled environment. A controlled environment and access to the input settings of the business game is the ideal setting for carrying out experiments.

The two games, PSG and PSG Extended, have been used for multiple years in Project Management modules at Ghent University, Vlerick Business School and University College London. Each time, the game settings have been carefully varied and controlled, and data on both student performance (game results) and satisfaction (student evaluations) have been analyzed properly to draw general conclusions for three types of communication experiments.



Project Management class at University College London  
(February 13, 2015, London, UK)

### Experiments

Communication, be it in business, blended learning or an educational environment, plays a vital role. Therefore, the controlled experiments for testing three different classes of communication, as well as the way in which the impact of the changed settings in communication on the learning experience is measured, are briefly discussed along the following lines:

**Sequence:** The sequence in which the various parts are shown to the student is often crucial for maximizing the learning potential, and determines how knowledge is built up along the different phases of the teaching process.

The sequence varies from a strict sequential approach offering small exercises along the session in the course to an integrative approach using an integrated business game capturing multiple themes.

**Format:** Since the use of business games requires a continuous interaction between the game player (student) and the computerized output, the way the data and information is communicated to the students influences their decision making process, both in terms of the final student performance as on their learning experience.

The simulated computer output that is displayed on the screen has been varied from project Gantt charts with a mainly visual overview but limited information, to data not well-structured, or a table with numbers presented as risk metrics (Schedule Risk Analysis) and control metrics (Earned Value Management).

**Expectations:** Expectations are also an integral part of communication. Since the computer generates uncertainty along the decision making process, the degree of generated uncertainty as well as the prior student knowledge about this potential uncertainty might affect the achieved results. In some settings, students were not made aware of the fact that they would operate in a highly dynamic environment, while in other settings, these students were briefed prior to the game and therefore prepared for the worst.

**Results**

Timing and sequence of communication is crucial in the learning process of students, and positively contributes to the learning experience and sometimes to the students' performance.

The communication format has a significant impact on the students' performance, and differs along their practical experience and background. However, no relation could be found between the format and the satisfaction of students during learning.

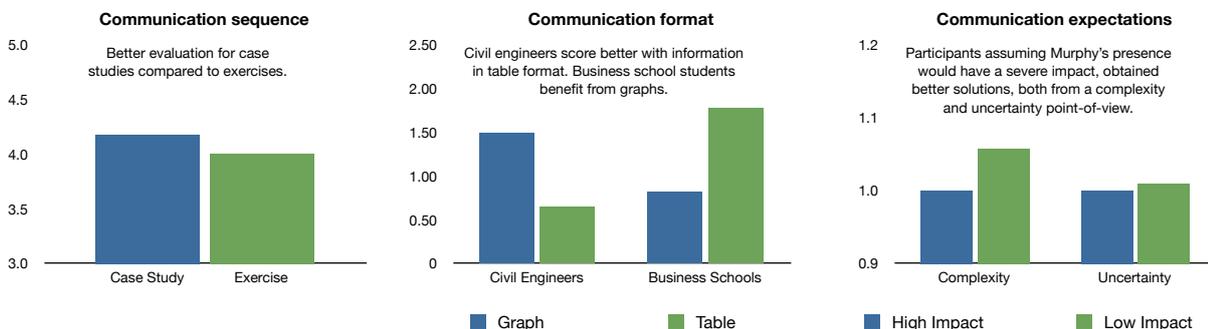
Finally, the student expectations had a major impact on the students' performance. It was found that students invest more effort and attained better solutions when the importance of reacting to uncertainty was stressed compared to situations in which students were ignorant and therefore did not expect a high degree of uncertainty generated by the computer game.

**Publication**

Some of the results on the perception of complexity and uncertainty experiments have been published in the well-known **Project Management Journal** in an article entitled "A Study on Complexity and Uncertainty Perception and Solution Strategies for the Time/Cost Trade-Off Problem".



The article is published in the Project Management Journal, volume 47, Issue 4, pages 29-50



Summary of main results of communication experiments (Presented in Lisbon, May 23, 2015)

# Experiments in the classroom (Part II)

## Identifying the skills of a project manager

**“All skills are perfected through the process of failure. Embrace loss as a necessary part of improvement.” - Jerry Lynch**

Given the increasing importance of projects, PM education is in high demand in projectized businesses. The education of future project managers is entrusted to universities and higher education entities, while current project managers can improve their PM skills through seminars and in-company training. One of the greatest challenges of the educational system in the future is to determine the focus of PM education since there is little agreement amongst training institutions on the skills of a good project manager.

Since managing projects successfully nowadays requires a mixture of skills, many researchers are convinced that focusing solely on technical competencies is insufficient. In the past decades, however, the PM literature and discipline appears to place more emphasis on hard (technical) skills at the expense of the soft (human) skills, although this trend has slightly changed in the past years. These days, no-one doubts that searching for a balance between hard and soft skills within PM education is critical to any PM course module. Easier said than done?

In most of my PM programs, I no longer rely on a standard classroom-teaching method but I'm using case studies and business games in order to better educate students a mix of hard and soft skills.

Key in case-based learning is that students take an active, rather than a passive, role in the learning process as new knowledge is better absorbed in combination with new and existing experiences (cf. other articles in this book).

### Experiments

During the course module, students have to solve a series of case studies, and must submit their results on a continuous basis. Their daily inputs are monitored and evaluated to determine the influence of the skill levels on the students' performance throughout the course module.

Three hard skills are defined and monitored:

- Understanding (comprehension of strengths and weaknesses of methods)
- Analysis (often called “analytical thinking”)
- Calculus (correctness of calculation)

Additionally, four soft skills are defined and monitored:

- Communication (integrating different views and opinions)
- Criticality (making sound judgements and decisions)
- Holistic (integrating exercises, often called “organisation”)
- Creativity (out-of-the-box thinking and flexibility)



Happy students at UCL School of Management (London, UK) have just finished their course module (picture taken on May 3, 2019)

## Experiments

The results are published in an article in the Journal of Modern Project Management, and are briefly summarized along the following lines:

### Experiment 1. Impact of skills on student performance

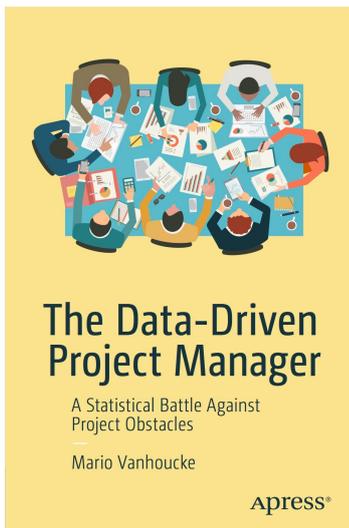
- Soft and hard skills impact the student performance
- Hard skills are mainly important at the start and end of the project
- Soft skills are important throughout the entire project

### Experiment 2. Improvement of skills

- Both the hard and soft skills improve throughout the course module

### Experiment 3. Validation of data-driven PM model

- Not all seven skills are equally important in each project phase
- Always a combination of soft and hard skills in each project phase
- Later phases require more skills (planning is easy, control is difficult)
- The analytical skill is the only skill that is always important



The five PM themes displayed in the bubbles are used in the five case studies from my book "The data-driven project manager"

## **PLAN** activity - network - project

Define activity estimates, construct a network and a schedule and analyse the chances to reach the project deadline

**PERT/CPM**

## **RISK** define - classify - analyse

Risk = probability x impact  
Define risk classes and analyse the risk using Monte-Carlo simulations

**SCHEDULE RISK ANALYSIS**

## **BUFFER** cut - plan - buffer

Remove activity protection and buffer the project

Solve resource over-allocations and construct a resource schedule

**RESOURCE BUFFER MANAGEMENT**

## **MONITOR** collect - measure - predict

Measure the project's performance while it is in progress and predict the impact of unexpected events on the final outcome

**EARNED VALUE MANAGEMENT**

## **CONTROL** alarm - focus - shoot

Generate automatic warning signals to detect problems during the project progress. Take actions whenever necessary!

**TOP/DOWN CONTROL**

# eLearning in times of crisis

## From technological issues to increased participation

**“eLearning shouldn’t be a casual joy ride on a Sunday afternoon with the cruise control engaged. The sole purpose of eLearning is to teach.” - Christopher Palm**

Teaching is like acting. Being on a stage, telling a story, entertaining students while talking about project management. I couldn’t even imagine that I could do it in a different way than standing on a stage in front of an enthusiastic audience.

And then suddenly, out of nothing, came COVID-19.

### On-campus teaching, or online teaching?

Travelling to London, China, Portugal was suddenly “mission impossible”, and everything needed to be replaced by online teaching via ZOOM and videos.

It wasn’t a very easy transition. The case studies I used in class could not be used in an online lecturing mode, and so I had to develop various new case studies that fit into an online breakout room. I also quickly learned that online talking requires a totally new way of teaching, and different ways of interacting.

In the beginning, I suffered, not knowing what I had to do to make the lectures attractive. And then we had

the numerous technology issues and other practical problems (e.g. my YouTube videos could not be watched by my Chinese students due to the Chinese firewall).

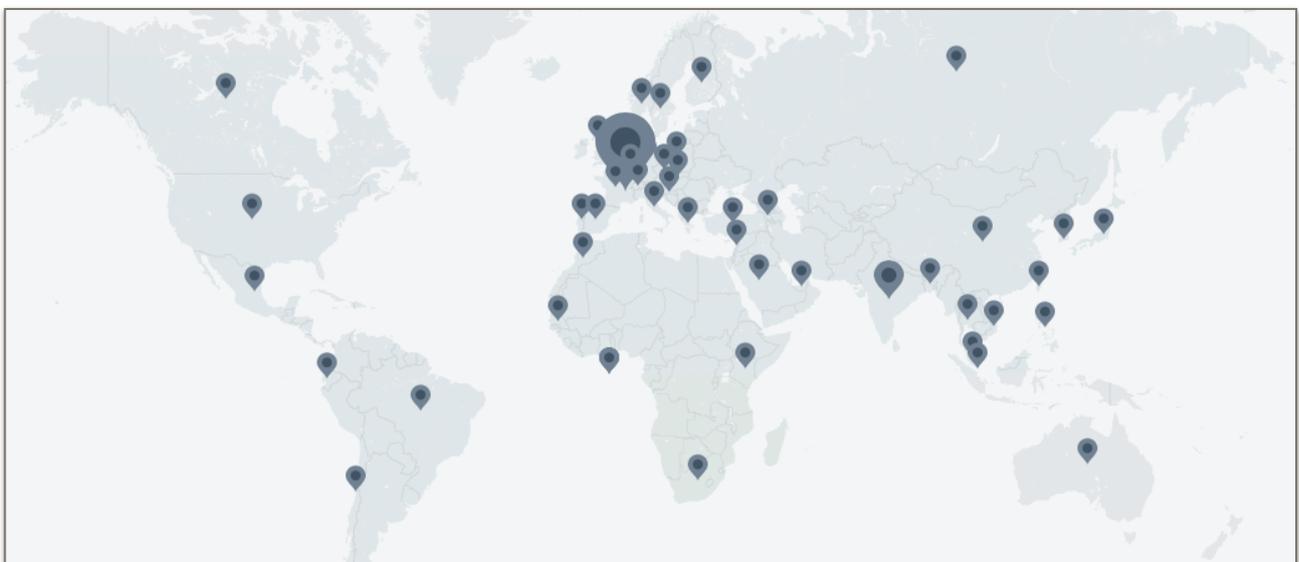
But soon, after some initial experiments, I started to see the benefits of online teaching: Students always come on time, are very interactive during lectures, work hard in virtual breakout rooms, etc. I also noticed that online lecturing creates some space for fun (telling a joke or showing some of my favourite vinyl records before closing a lecture, I love it).

### The video room

I created a whole list of short videos that I shared with my students to wrap up the most important themes discussed in each lecture. Between March 15, 2020 (1st video put online) and March 15, 2021 (exact one year later), I saw 21,257 views in total passing by. And this number is still growing...

I don’t think I can or want to go back to teaching without supportive videos. Of course, none of the videos will ever replace my on-campus lectures, but they’re not just an add-on either. Instead, they constitute a crucial part of the student’s learning experience.

Long live online lecturing and eLearning!



Students are watching my project management videos all over the world. Amazing!

# PMI Belgium's University Contest

## A recognition of young PM potential

**“Praise youth and it will prosper.” - Irish Proverb**

The yearly award for the best thesis in Project Management as well as the university contest award for the best group work of master students during the Project Management course at the Faculty of Economics and Business Administration of Ghent University (Belgium) are two ways to get the students involved in the professional PM world. PMI Belgium wants to collaborate with Ghent University to show the relevance of their activities to the most promising group of project managers, our youngsters and future professionals, and appreciates the students' view on the discipline.

### University contest

A group work for the PM course has to be finished before the final exam and is evaluated as part of the course. After this, the following approach is taken to choose the winner of the university contest:

- The 3 best reports are submitted to PMI Belgium
- A PMI jury of professionals selects a winner
- The official award is handed over during a PMI Belgium chapter event

### Best thesis award

The final Master thesis acts as a professional qualification for each Business Engineering student at Ghent University. Each year, the best thesis on a Project Management topic, guided by promotor Mario Vanhoucke is nominated for the yearly best PM thesis award by PMI.

### Relevance & exposure

PMI is the biggest professional organization of project managers worldwide. Stepping in the professional world while you are still in your academic student life gives you the advantage to learn early in your career how, when and why PMI can be beneficial for you. And, less important but nice to have, it shines bright on your early CV! The winners of the award are mentioned on the PMI Belgium website, and in some occasions, in professional magazines such as PM Network and PM

Today. Moreover, they receive a cash price to be divided among the group members.

### Praise youth

In 2014, an article has been written to summarize the effort made by PMI Belgium and Ghent University to nominate and award students for their hard work and excellent results in Project Management. The article gives an overview of the **blended learning** approach taken in the course “Project Management”, and elaborates on how the contests and awards give students incentives to get involved with the professional PM community, years before they start their professional career. By awarding written work and involving them in chapter events and workshops, they get the recognition they deserve. As is the case with all prizes and awards, only a happy few finally get the award and (cash) price, while many others also get nominated but do not end on the podium. This recognition and this process of getting them involved leads to an increased enthusiasm, more engagement and eventually a higher quality of the written and oral work, and hence their knowledge and appreciation of the Project Management discipline. This article gives a short summary of the praise and the hard work of students since the award initiation in 2011.



PMI Belgium's recognition of young PM potential  
(Journal of Modern Project Management, 2 (2), 112-117)  
(download from [www.or-as.be/blog/jmpm\\_2014c](http://www.or-as.be/blog/jmpm_2014c))

## Wall of fame

The University Contest winners of the previous years are summarized along the following lines:

- Edition 2019: Inès De Braekeleer, Marie-Julie De Bruyne, Renée De Visscher, Louise Martens, Eva Moens: "Project recovery: different failures and how to get rid of them"
- Edition 2018: Annelies Martens: "Buffer management methods for project control"
- Edition 2017: Olivier Van Raemdonck, Gauthier Dejonckheere, Bram Devlieghere, Maxim Pitteman, Laura Vanacker: "Baseline schedule and risk analysis: Exhibition stand at BISbeurs"
- Edition 2016: Ellen De Backer, Rani Torrekens, Laurine Van Buggenhout, Mathilde Van Caeckenbergh, Karen Verhaeghe: "De Waalse Krook: Risk Assessment using the Fuzzy Set Theory"
- Edition 2015: Camille De Cock, Ellen Dekoning, Adeline Dewaele, Miguel Garcia Casado, Jessica Seurinck and Ann-Sophie Tytgat: "Dynamic scheduling of a new project: Building wireless smart cities"
- Edition 2014: Astrid De Keyzer, Jolien Dobbelaere, Shana Raes, Lisa Vandevoorde and Dorien Van Steenberge: "Managing product innovation: A study of product innovation in project management"
- Edition 2013: Pearl Debeurme, Sanne Diependaele, Ann-Sophie Parmentier, Julie Scheipers, Hanne Vanaelst and Eline Van Lombeek: "How to improve project team dynamics: Team building workshop"
- Edition 2012: Lien Vehent, Mélanie Decq, Jannig Theeten, Philippe Peelman and Philip Pensaert: "Windmolenpark Maldegem"
- Edition 2011: Alexander De Cuyper, Jan Dierckx, Peter Van Vooren and Hristo Petrov: "Impact of methodology and software on the planning of a construction project"

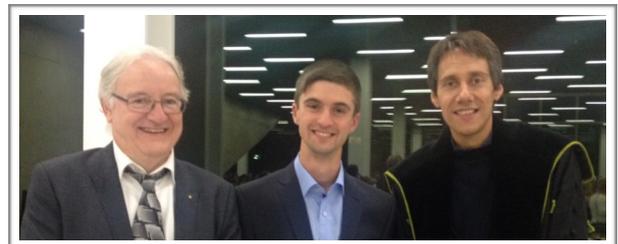
The best thesis award winners of previous editions are:

- Edition 2020: Brent Cathelyn and Arne Van de Walle: "Quality objectives in project scheduling: A simulation and case study to assess the implementation of showstoppers"
- Edition 2019: Arne Van Belleghem: "Functional requirement-based forecasting: Estimating the cost and duration of early-stage projects"
- Edition 2018: Evelyn Mareels and Jens Martens: "Earned Duration Management: Evaluation and extension of a novel project control technique for the time dimension"
- Edition 2017: Jeroen Santens: "Incentive contract design for stochastic projects"
- Edition 2016: Thomas Govaert: "Using Data Envelopment Analysis to support project success"
- Edition 2015: Tom Servranckx: "A study to the impact of schedule adherence on the accuracy and stability of forecasts"

- Edition 2014: Annelies Martens: "Statistical Project Control"
- Edition 2012: Pieter Leyman: "A genetic algorithm for the multi-mode resource-constrained project scheduling problem with discounted cash flows"
- Edition 2011: Evelyn De Blicke and Ellen De Groot: "An accuracy study on Earned Value Management extensions using Monte-Carlo simulations"



Third edition of PMI Belgium's Best Thesis Award  
(September 27, 2014, Ghent, Belgium)  
From left to right: Mario Vanhoucke, Jacques Neyns,  
Annelies Martens, Dirk Huyers



Fourth edition of PMI Belgium's Best Thesis Award  
(September 25, 2015, Ghent, Belgium)  
From left to right: Jacques Neyns, Tom Servranckx and  
Mario Vanhoucke

# Teaching Abroad

## A class with only students, and no teacher

**“Simple exchanges can break down walls between us, for when people come together and speak to one another and share a common experience, then their common humanity is revealed. We are reminded that we're joined together by our pursuit of a life that's productive and purposeful, and when that happens mistrust begins to fade and our smaller differences no longer overshadow the things that we share. And that's where progress begins.” - Barack Obama**

Teaching abroad as a professor is a choice I have (accidentally) made when I was much younger than today, but I still don't regret it at all. After all these years, it's still like giving a performance to an audience you hardly know, with unknown expectations and a completely different background. Each time, it feels like a new step in the dark, but it's probably the most inspiring activity of my professional career.

Indeed, sometimes you need to get out of your comfort zone to come back with a renewed enthusiasm and a knapsack full of fresh experience that you can adapt and embed in your own hometown environment. That is why I like to go abroad for teaching a full time course for master students in universities, MBA students in business schools and/or professionals in company trainings. It broadens my scope, sharpens my attention for new challenges and enriches my knowledge on how to interact with various types of people. And that is what teaching is all about... isn't it?

### Where, what, how?

I believe that the choice of the country is not very crucial to share experience on Project Management and Control, since it is a topic that is necessary and relevant everywhere in the world. I learned a lot from all my stays abroad, not only from my yearly teaching assignments in the UK, China and Portugal where I can update my approach on a yearly basis to better serve the students' needs, but also from my occasional teaching assignments in the US, Suriname, Lithuania, Portugal, Denmark and Spain.

In Suriname, the focus on nature projects, including the construction of a Dam for the Brokopondo lake, the installation of a water purification plant, and the use of automated Drones for nature conservations were fine-tuned to the experience of the students. From my teaching session in the UK (mainly London), I learned that big capital intensive projects at UK Railways and the Airport require a detailed and intensive project control approach that needs to be adapted and fine-tuned to the specific UK setting (which is fundamentally different from the European approach I am aware of). The Chinese sessions were focused on planning and risk in high-rise building construction, chemical plant maintenance projects and big airport infrastructure projects.

And every time I try to adapt my class sessions to the students' business experience or learning environment, I believe I am the one who learns the most.



Front cover of the second edition of this book has been taken during my Suriname stay (2013 - 2014)

### My own experience

One of the most important challenges in teaching abroad for me is to be able to adapt and to cope with these little differences between countries. A few examples are given below:

- Interaction is done in various ways. Interacting with people using case studies, business games and group discussions is discussed elsewhere in this book. I learned throughout the years that the type of interaction heavily depends on the background of the students. Sometimes it is a group discussion that works well and at other times it is the business

game with individual feedback that makes the course a success. Interesting!

- Jokes are different. It's not that I'm telling jokes all the time during class, but the little things that make people smile (and often attract their attention in case they lost it) are so important but are also so fundamentally different between countries. I learned not to prepare these little things, since it is so uncertain to predict whether they work or not. Fascinating!
- The cultural differences are difficult in the beginning, but are the most exciting afterwards. These tiny little differences between countries are everywhere hidden or visible in class. It ranges from various ways of approaching the teacher after class (e.g. what a difference between Belgium and China), assigning deadlines for case studies (e.g. settings strict deadlines in South America is so strange) or even the punctuality of starting class (e.g. I don't think I ever started (the empty) class on time in Lisbon, but once everyone was there, I had their 100% attention). Incredible!

I honestly hope and believe that the students learn something from my teaching sessions, but I also realize that I learn at least as much, and probably more, from their experience they share with me and the way they interact. This is exactly why teaching abroad is so amazingly inspiring, and brings me back home with renewed experience to be used in my hometown university. The class sessions abroad just feel like a collaborative learning experience between the students and myself. It's not like lecturing, it's like a class with only students, and no teacher.



Nice group of students at Anton de Kom University during my 2017 stay

# Welcome to Peking University

## Five observations from Beijing

**“Business schools don't create successful people. They simply accept them, and then take credit for their success.” - Josh Kaufman**

The Beijing International MBA (BiMBA) at Peking University (Beijing, China) was founded in 1998 as the first joint international MBA program in Beijing approved by the Chinese government. It is a joint educational venture, between Peking University and its global partners, operated by the National School of Development at Peking University. On the background of China's reforms and modernization practices, BiMBA is operating in the excellent academic atmosphere and a long line of research traditions at PKU. It is committed to active participation in high level dialogues with local and global leaders, discussing China's present reforms and future development as well as the reconstruction of a global new order. Its goal is to cultivate corporate leaders who are familiar with China's market environment as well as international business practices and are thus empowered with a global vision and a local mindset.



Beijing International MBA (BiMBA)

Every year in October & November, I teach a course **Decision Making for Business** at this BiMBA program, both for the full-time students (during the week) and the part-time students (during the weekends), resulting in a very intensive course covering topics such as optimization, risk management, simulation, project management, and much more, supported by technical lectures, business cases and practical state-of-the-art stories and experiences.

### Top 5 observations

Teaching at Peking University and therefore staying abroad in a totally different world is always an adventure, never feels like a routine job and every time creates some unforgettable experiences for life.

**1 Excellent students.** Peking University is known as a top university in China, ranked first or second, depending on the kind of rankings, and you can feel this in the quality of the students. Written work is of a very good standard, and class contributions are thoughtful and well reasoned. The students are reliable and active, always participating in class discussions. They most definitely have the skills to cope with highly rigorous and intellectually demanding subjects, which results in teaching sessions that are interesting and inspiring for both the students and the lecturer.

**2 Work & pleasure.** Honestly, it is my personal belief that it is sometimes difficult to find the right balance between being a lecturer in charge of my teaching sessions and being a colleague or friend to these MBA students. Indeed, mixing work and pleasure is like walking on a fragile bridge between commanding respect and establishing friendship. But what is striking in Beijing is that the otherwise very professional students suddenly become young and lighthearted people who like to make fun with you during a dinner or when drinking a beer. During pleasure, we say “take care” to each other, but the next morning, it's back to business and I hear “Hi Professor” before I start my next teaching session. In Beijing, I don't feel uncomfortable when it comes to mixing business with pleasure.



The full-time Beijing International MBA group 2016  
(November 9, 2016, Beijing, China)

**3 Food variety.** I'm a huge fan of the Chinese cuisine all over the world, and even cannot withstand the temptation to visit China town every time I visit London. But it means nothing compared to what I've tasted in Beijing. Visiting local restaurants for delicious authentic Chinese meals with a group of BiMBA students is every time a joyful and tasty experience, and includes styles originating from the diverse regions of China. The restaurants are nice, and the food is simply excellent! My mouth is watering when I think back of the lunch breaks and dinners in Beijing.

**4. APEC blue sky.** It is no secret that the Chinese capital has for many years suffered from serious air pollution. On every Beijing visit, the real-time Air Quality Index (AQI) reaches unprecedented and critical levels, and this is certainly a concern for every one visiting or permanently living in this town. That is certainly a facet that I don't like about Beijing, but not during my last visit

...

During my visit in November 2014, the Asia-Pacific Economic Cooperation (APEC) Summit 2014 was held in Beijing. This is an important business event during the APEC Leader's Week to discuss Asia-Pacific economic issues and promote regional trade, investment and cooperation, gathering +1500 APEC Economic Leaders, CEOs and leading thinkers in Beijing to deliberate the key issues facing the development of the Asia-Pacific economy. The effort to impress visiting foreign dignitaries gave locals a literal breath of fresh air, by limiting the number of cars on the road, forcing companies to reduce their production, and other measures taken by the government. It goes without saying that the many newspapers criticized this approach, but I, at least, liked it, since fresh air and low levels of pollution allow you to see and enjoy the beauty of Beijing. It even has led to the new, sarcastic phrase, "an APEC blue sky," which means a beautiful and ephemeral clear blue sky without smog and dust all around.



The part-time Beijing International MBA group 2016  
(November 6, 2016, Beijing, China)  
(afternoon class)



The part-time Beijing International MBA group 2016  
(November 6, 2016, Beijing, China)  
(morning class)

**5. Stepwise integration.** After a few years of Beijing visits, I realized that doing business and building relationships in China is not an easy task. It requires some unpublished knowledge about business culture, business etiquette, meeting protocol and negotiation techniques in order to fully exploit the relationships with local people. It is probably a process to accepting differences between habits and cultures, learning to understand the reasons of these differences, and sometimes even trying something new without fully understanding why or how. Cross-cultural understanding is an important tool for learning to appreciate different people's way of working and living, and I have the impression that it becomes easier along the years. My occasional visits at people's home for dinners, parties or business meetings have taught me to appreciate and even cherish these differences. I was pleased to enjoy some really weird and fundamentally different evenings together with local MBA students or business people that I will never forget. Respect is what I feel on such a moment.

Every year at the end of a heavily loaded teaching period, I evaluate the pros and cons of staying abroad for a few weeks. Every year I realize that the "home sweet home" expression is so very true, but I also conclude my final teaching session with the famous words of Arnold Schwarzenegger "I'll be back!". It's a pleasure and privilege to teach these wonderful and enthusiastic students the miracles of decision making!

Looking forward to next year's edition.

# From London to Beijing

## 20 Years BiMBA at Peking University

**“When you live in Beijing for a while, you gain a finely tuned understanding of air.”**

- Evan Osnos

Since 2010, I have been visiting Peking University on a yearly basis, and now after all these years, it is time to look back and review why I keep doing this. It's needless to say that I enjoy my trips to China, since I wouldn't have written such a positive review about Beijing in my other article in this book (“Welcome to Peking University: Five observations from Beijing”). But it's not all fun. Beijing has its problems too: first, there is the long flight and I really hate waiting +10 hours in an airplane seat. There is also the pollution, which is dramatically bad at some times. Finally, there is the cold temperature: I mostly visited Beijing in the fall (October and November) and it is rather cold then. You must know, I really love the sun, even when I am at work (mostly inside).

All my fall visits to Beijing were organised by Vlerick Business School (Belgium), where I am a professor since 2001, but in 2018, I went to China as a professor of UCL School of Management (UK), and this time it was in June. It was my very first stay in Beijing in the spring. And in the spring, things are different in Beijing... What a nice weather! What a clear-blue sky!

### Looking back

It's not that I had no fun in the fall. I mostly have not much free time to make a lot of fun, but I occasionally try to grasp some precious moments. I work hard when I am in Beijing. I teach in the week and the weekend, and I hardly have time to take a break. But that doesn't mean that there is no place for nice times! As I said, it mostly is the end of October, rather cold, sometimes rainy, and the air is heavily polluted. But in-between the teaching sessions, during these spare moments of free time, I take what I can to enjoy my stay.

One of the most inspiring free moments I had, was in 2016, during the evening dinners with my South African friend, Professor David Venter. He is a wonderful storyteller, a really smart and interesting person with a lot of (life and teaching) experience, but above all, when you meet David, his personality goes straight to the heart.



With David Venter from South Africa in Beijing, 2016

I really enjoyed his wonderful stories about his collaboration with Nelson Mandela, and I still have not finished yet reading all the books he recommended to me. Our discussions about our mutual interest in the same kind of books have had an everlasting impact on me, and I cherish our short talks until today (and I still hope I'll find some time to visit him in South Africa).

### For the very first time

But as I wrote, in 2018, I travelled to Beijing in the spring. A new time of the year, as a professor of another school, so despite the familiarity of the place (Beijing), it felt like a new adventure. I noticed four major changes compared to my fall visits:

#### I. Enjoying the summer:

It was June 2018, and I can tell you: it was really, really, yes really nice weather! Technically speaking, it was the spring (early June), but it felt like a very hot summer for a guy from Belgium! I wish that the summers in my country were like the springs in Beijing. Walking in t-shirt to the class, taking a break in the sun, it makes a difference, for me, but also for the students. What a joyful experience!



## II. From London to Beijing:

My June 2018 trip was also the first time that I visited Peking University as a professor from the UCL School of Management programme (UCL, London). As said, in the previous years, I visited the Beijing International MBA programme (BiMBA) as a professor of Vlerick Business School (VBS, Belgium). But in 2017, BiMBA decided to start a collaboration with UCL, while keeping its collaboration with VBS. Life is full of surprises, and the fact that I work both for Vlerick Business School and UCL School of Management, both taking a part of the BiMBA pie, is just a nice coincidence that keeps me close to the BiMBA programme I love so much.

## III. Anniversary:

In 2018, BiMBA celebrated its 20th anniversary. Of these 20 years, I was a small part of it for almost half of its existence. BiMBA must be proud on how they grew and how they evolved into a professional programme with friendly and exceptional students from different parts of China (and abroad). Me, I'm proud to be part of this wonderful journey!



## IV. Promoting a book:

In my 2018 spring edition, I did not only focus on teaching, but I also took some time to promote my new book "The Data-Driven Project Manager" (cf. the bookstore elsewhere in this book). On every occasion possible, I promoted my book. I accidentally jumped into a conference (I was not registered) to replace a no-show and I talked about my book to an unknown audience. I also visited other classes as a guest lecturer, and talked to various people about why this book might be relevant to them. Even Apress, my publisher, saw pictures on LinkedIn about my visits in China, and they reacted that the Chinese representative will help me to promote my book in this wonderful country. I hope they'll keep their promise.

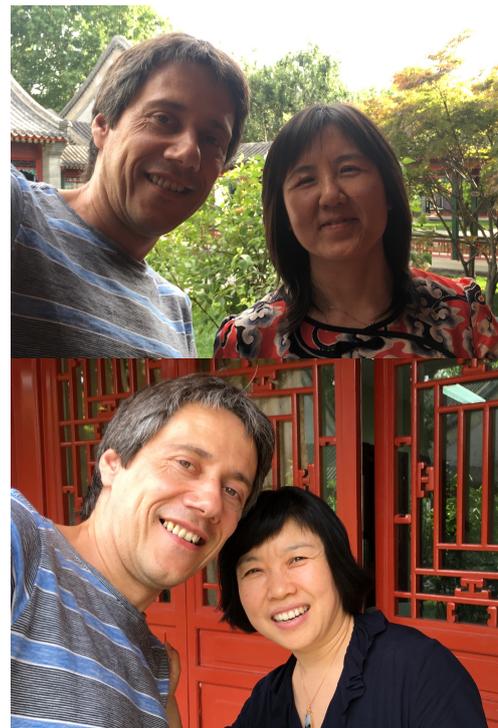
### Same old thing

Of course, with the shift from VBS to UCL, some things changed at BiMBA, while other stayed the same. But the good things never change: The students were nice as always. And they work hard. The pollution is better in the spring compared to the fall, and I'm hopeful: I'm not sure, but I think the pollution is improving over the years. Let's hope.



Like a real author, signing books (2018)

Over the past 10 years I've been in Beijing, there were fortunately two constants that are worth mentioning. First of all, **Cathy Due** has always been there to help me with anything and more. Her knowledge of the programme, her close contact with the professors and the students, and her deep knowledge of the (business)



Cathy Due (top) and Wendy Tong (bottom)

world around the MBA makes her the person to solve any problem that pops up. Moreover, **Wendy Tong** has always been there to help me with any practical problem: from ordering a taxi to getting an umbrella when it rains, Wendy is there! Thanks both of you!

# Moving to the south

## Welcome to Xi'an

**“Once a year, go someplace you’ve never been before.” - Dalai Lama**

### Jump, if you can!

If I could travel to a new place every day, I would jump at that opportunity in a heartbeat. Unfortunately, the opportunity is not permanently present for most of us, but only comes along once in a while at very irregular and unexpected times. That’s why I constantly keep my eyes open, I look around all the time, and sometimes actively search for an opening... and when I see it coming, I jump. That’s what I did that late November week in 2017.

### Moving to the south

I was teaching in Beijing, as I always do, and unexpectedly had a free week in between two teaching weekends. I hate free weekdays in a foreign country (except when on vacation, which was obviously not the case). I had no clue what I could do during that week, except... I had been in contact with Professor He Zhengwen for some time, and I asked him to book a high-speed train from Beijing to Xi’an. A visit and some joint work would be fine. The next Monday morning, I sat on the train at a speed of 300 km per hour, and 5 hours later, I arrived in Xi’an for the very first time in my life. It wouldn’t be my last time.



I promised He to tell something about my research, and had the opportunity to have a room with +20 young PhD students as an audience. They gave me a two-hour slot, so I decided to spend one hour on my research i.e. I talked about the problem formulation, the methodology, the academic contribution and the practical value, ... the usual stuff. The next hour, I decided to switch the topic and started thinking about how I could persuade these young people to do research with passion. I told them why they should carry on with their research career, and what they should do to maximize chances to success. It has been the second hour that was the most inspiring one, people told me afterwards.

### Two universities

Of course, I wanted to do more than just talking about my research results, and together with Professor He Zhengwen from **Xi’an Jiaotong University**, we organized a workshop with all the PhD students of his department. Each one of them had to present their work, and I had to comment. It was an informative experience, certainly to me, and hopefully also to the students.

I also had the privilege to meet Jingwen Zhang from the School of Management from **Northwestern Polytechnical University**. We collectively decided to start up a research collaboration and signed a formal contract to incentivise our plans. And of course, that includes recruiting new PhD students. Jie Song is one of these students who came to Belgium in 2017 to stay with us for three years. Hopefully, many more will follow.



Signing a formal collaboration with Jingwen Zhang (Northwestern Polytechnical University)

## Nice (young) people

Unquestionably, the most unforgettable part of my visit to Xi'an was my trip with the young people of the university.

First, there was my driver Hua He (何华, a.k.a. sunflower) who brought me everywhere I wanted to go. Then I had Yangting Wang (王艳婷) who visited Belgium and stayed at my research group for 6 months in 2016 - 2017. Together we have written the paper "On the performance of priority rules for the stochastic resource constrained multi-project scheduling problem" published in Computers and Industrial Engineering. Finally, I enjoyed the jokes, stories and tales of Zhiqiang Ma (马志强, foreign people call him Martin), who also has stayed a year in Belgium at the University of Leuven.

These people showed me Xi'an in all its beauty and colours!

Of course, we visited the Terracotta Army, a collection of terracotta sculptures depicting the armies of Qin Shi Huang, the first Emperor of China. It is a form of funerary art buried with the emperor in 210-209 BCE and whose purpose was to protect the emperor in his afterlife.

The trip to Li mountain (骊山) and Huaqing hot spring (华清池) was exciting, that's the least you can say. In order to avoid huge entrance fees, hiding in the back of a car is the trick. But beautiful it was!

The beautiful lake and big palace at the Lotus palace of Tang Dynasty (大唐芙蓉园) and the show I saw there about the famous Chinese story Journey to the West was inspiring and breathtaking.

And of course, the good local food market, the so-called Muslim's Quarter (回民街) was the icing on the cake. You could find all about the traditional food of Shaanxi, and most of the restaurant owners are muslim. That's why we opted for a local dish called 羊肉泡馍. Try it yourself! It's delicious! You get the best food in China when you visit the restaurant with locals. Not only because they can read the Chinese characters (which I still can't read), but particularly because they know better than anyone else how to combine the different plates and make it a delicious adventure.

Needless to say that my first trip to Xi'an in 2017 was an unforgettable experience, thanks to these young people. They have spent a few days with a guy of 45 (me) when they are only in their early twenties! It's not straightforward, but we had a wonderful time, and I am very grateful for how they took care of me, that strange-looking, somewhat older foreigner in an unknown country.

## Second visit



In 2018, I went to Xi'an again, and visited the new campus of the Northwestern Polytechnical University. Wow! It's like a city on itself. Hypermodern buildings, state-of-the-art technology, a university of the future! We collectively decided to strengthen our collaborations, and I hope you will hear from us in the near future with beautiful research results.



The people who made my trip an unforgettable experience  
(from left to right: Zhiqiang Ma (马志强), Weibo Zheng (郑维博), Yanting Wang (王艳婷), yours truly, He Zhengwen (何正文),  
Jingwen Zhang (张静文) and Hua He (何华))

# UCL School of Management

## Be prepared for the future

**“The best way to predict the future is to create it.” - Abraham Lincoln**

### University College London

University College London (UCL), one of the world's leading universities, has established a new School of Management, replacing the department of Management Science and Innovation, and rebranded it to **UCL School of Management**.

The new school will expand the current research and teaching in business and management, with a focus on innovation, technology management, analytics and entrepreneurship.

New programmes are available for postgraduate students in management, finance, business analytics and financial technology entrepreneurship. The School also offers a range of undergraduate and postgraduate programmes, and plans to extend to other masters are on the agenda.

### An entrepreneurial mindset

On the website of UCL School of Management you can read that their mission is to create disruptive research and entrepreneurial leaders for the complex, interconnected world of the future. In my 8 years at the University College of London, I have witnessed this entrepreneurial mindset in both the teaching and research activities of the school, and I had the privilege to actively participate in these inspiring activities.

**Teaching:** Students are active participants, eager to learn, with a strong education from a range of various fields, and a very diverse cultural background. This cultural diversity and the entrepreneurial ambition of the students make UCL School of Management a pleasant environment to teach.

**Research:** The primary focus on innovation, technology management, analytics, and entrepreneurship motivates research within three research groups: Organisations and Innovation, Strategy and Entrepreneurship, and Analytics and Operations.

### Course modules

In my data-driven Project Management course module, students are confronted with the theoretical background as well as practical relevance necessary to understand how a project should be managed. With a strong focus on analytical skills and a critical view on integrated project control, students are expected to actively participate in all class sessions.

The course module provides students/managers with the necessary requirements to plan and control projects. The emphasis is on making well-informed project decisions by monitoring their performance and predicting their expected timing and costs.

### Canary Wharf

Most programmes are taught in the School's new campus in Canary Wharf, the UK's major global business district. It is one of the United Kingdom's two main financial centres – along with the traditional City of London – and contains many of Europe's tallest buildings, including the second-tallest in the UK, One Canada Square, where the new school is located at level 38.

### UCL school of management:

<https://www.mgmt.ucl.ac.uk>

### My personal profile at UCL:

<https://www.mgmt.ucl.ac.uk/people/mariovanhoucke>



Level 38 of One Canada Square in Canary Wharf  
(UCL School of Management)

**“Latins are tenderly enthusiastic. In Brazil they throw flowers at you. In Argentina they throw themselves.” - Marlene Dietrich**

### Brazil

Work hard. Live hard. It doesn't sound something people typically link with the relaxed atmosphere Brazil is known for, but nothing is what it seems. The trip to Brazil was an exciting rollercoaster, I gave various lectures to business people, have met researchers, professors and practitioners with whom I will work in the future, I attended meetings in various cities and took more flights in two weeks than I normally do in a year (which was with my fear of flying the less pleasant part of the trip).

I gave lectures to project managers in the business atmosphere in São Paulo, in the sun and heat of Rio de Janeiro, and the green city Curitiba, the largest city of the Brazilian State of Paraná. Each time, the audience and the approach was slightly different, but they all were as enthusiastic as Latin Americans can be. They didn't throw flowers, but the many handshakes and thank you's at the end of the lectures were highly appreciated.

### MundoPM

The organisation of the lectures was done by MundoPM, a Project Management training company led by colleague and friend Osmar Zózimo (cf. article “The Journal of Modern Project Management: Enhancing theory and managerial significance”). He is the founder and driving force of the Journal of Project Management and is also responsible for many Portuguese articles on Project Management in his local journal MundoPM. Our articles with Paulo André and Floriano Salvaterra are published in this journal, and are available on [www.or-as.be](http://www.or-as.be).

### Curitiba, the State of Paraná

I always had a bond with Brazil, even before I have met Zózimo, and even before I even realized I had a bond. In my book “Project Management with Dynamic Scheduling”, I have put three case studies that I had written long before I started writing the book (cf. article

“Project Management case studies: A student should be an active participant, not a passive consumer” in this book). Back in 2002, I wrote three case studies that I urgently needed for my new Project Management course, entitled “The Paraná bridge case study” (part I, II and III). I remember that for an unknown reason, I wanted to use Portuguese names. I asked my Portuguese friend José Coelho (cf. article “With José Coelho: About research and passion”) to send me some Portuguese names and he gave me some names from his cell phone. Then, I randomly selected some Brazilian places I had never visited, and I created three artificial bridge construction projects with the names Mutum-Paraná II, Iguaçu III and Bermejo I. More than 10 years later, I visited these places, and used the case studies in my lectures. Life is strange...

During my stay in Brazil in 2016, I visited the Itaipu Dam, a hydroelectric dam on the Paraná River located on the border between Brazil and Paraguay. The same river that I used in my case studies! I couldn't be more

**SPECIAL DAY**  
PROJETOS LIDERANDO FRENTE DE NEGÓCIO  
2016

**THE BIG DATA PROJECT MANAGER:  
SCHEDULE RISK AND PROJECT CONTROL.**

**HARDER, BETTER, FASTER, STRONGER!**

Controlling projects using Earned Value Management has become a standard in managing and measuring the performance of project portfolios. It has been used for both large and small projects in various sectors, and has been subject to a lot of research. However, despite its widespread use, there are still major opportunities to further enhance the knowledge of the project management control system.

**LEARNING OBJECTIVES:**  
The participants of this workshop will be able to:

- Understand the use and relevance of schedule risk analysis
- Identify the best performing methodologies to assess a project's risk
- Access a huge database of empirical projects to apply novel techniques
- Understand the importance of scheduling and risk for use in project control Understand the main principles of Earned Value Management and its extensions.

**Prof. Dr. Mario Vanhoucke** is a Full Professor at Ghent University (Belgium), Vlerick Business School (Belgium) and UCL School of Management (University College London, UK). He teaches "Project Management", "Applied Operations Research" and "Decision Making for Business". He obtained a Master's Degree in Business Engineering (1996) and a PhD in Operations Management (2001), and he currently is director of EVM Europe ([www.evm-europe.com](http://www.evm-europe.com)) and partner at the company ORAS ([www.or-as.be](http://www.or-as.be)). He is responsible for various research projects in the field of Integrated Project Management and Control, which has led to more than 60 papers in international journals, four Project Management books published by Springer, 2 free online books ([www.or-as.be/books](http://www.or-as.be/books)), three computerized business games and an online learning platform known as PM Knowledge Center ([www.pmknowledgecenter.com](http://www.pmknowledgecenter.com)). His research has received multiple awards, including awards from PMI Belgium (Belgium 2007), International Project Management Association (Italy, 2008) and the American Accounting Association (USA, 2010) and multiple awards from Belgian companies.

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Organização  
**MPM**  
PROJECT MANAGEMENT

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Announcement of my lectures on the big data project manager for MundoPM (download from [www.or-as.be/downloads](http://www.or-as.be/downloads))

excited. I was impressed by the size of this project, but I was equally touched by the fact that I was standing at a place that I used in one of my writings more than 10 years after I wrote about it. Time flies, and fate happens!

### One day in the life of Zózimo

Apart from the hard work in the serious business of Project Management, Zózimo also introduced me to a new concept. As a guest in a foreign country, I mostly have the privilege to have dinners in fancy restaurants, accompanied by the often boring talks about our job, and the like. It's part of the business. But not for Zózimo! He wanted to show me how he lived. He picked me up early in the morning, and together with his and my wife, we were thrown into the life of Zózimo. In this "one day in the life of Zózimo", we have visited places he normally visits during a working day or when he is taking a day off. I visited his house, met his son and had dinner in a local restaurant on a Sunday afternoon. Nothing fancy. Nothing special. But a great experience to get to know how Zózimo lives.

We visited the head offices of MundoPM, had a coffee break at a local and very cosy coffee shop (where you have thousands of different coffees, just like the wide variety of beers in Belgium), we went to a shop for ice cream and visited the lake of Parque Barigui at the way back home where we saw these typical Brazilian animals Capivaras, and drank a glass of Caldo de Cana (Sugarcane Juice). Great concept. One day in the life of Zózimo!



Staring at the Paraná river during my visit to Brazil in 2016

(I was touched when I finally saw the river that I wrote about in my first case studies +10 years earlier. Life is full of surprises and coincidences.)



One day in the life of Zózimo  
(with Zózimo, myself, my wife Gaëtane and Zózimo's wife Melissa)



Panoramic view of the Itaipu Dam  
(clearly impressed by the size of this huge project)



# Managing health care PM at the International Academy of Osteopathy

“Change before you have to.” - Jack Welch

## International Academy of Osteopathy

The IAO is an international school for osteopathy with sites in Denmark, Egypt, Poland, Belgium, the Netherlands, Germany, Austria and Switzerland. The students can obtain the Diploma in Osteopathy (DO), the Bachelor of Science with Honours in Osteopathic Studies and/or the Master of Science in Osteopathy in collaboration with Buckinghamshire New University (UK) and the University of Applied Sciences - Tyrol (Austria).

## Accreditation

The IAO is doing well. No doubt about that. In their search for accreditation, they collaborate with some well-known universities as mentioned previously, and extend their program with some business-oriented course modules, such as ... Project Management! As an example, currently, the full Master, which is worth 120 European credits, complies fully with the Bologna Process. Unique in Europe!

## Content

I have to admit that I don't know anything about Osteopathy and initially had no clue how I could link my Project Management course module with the profession of an osteopath. Gradually, I learned that some of the topics could be easily translated into their setting. Project Management typically is something that can be used in a very broad range of settings, from construction, to IT, to ... well... osteopathy!

I teach the students how to set up a simple plan. Nothing advanced, only the basic principles. I show them that they should have an idea about risk. No advanced calculations, just the idea. I show them that they should monitor and control their projects. No advanced statistical analysis, just the underlying principles of Earned Value Management.

I think that is more than enough for these students. Project Management will never be their core business, but they can and will use it in their daily life. And for me... well, health care won't be my core business either. But it's nice for a change!



The classroom of my Project Management course module at the International Academy of Osteopathy  
May 2016 (left) and October 2016 (right)

(Look at the classroom! They use the patient tables as office desks!)

# Project managers and engineers

## Building bridges with teaching

**“One of my beliefs about leadership is it's not how many followers you have, but how many people you have with different opinions that you can bring together and try to be a good listener.” - Robert Kraft**

### Cloostermans

Training people in companies is (most of the times) fun, challenging, exciting, hard work, inspiring, and much more. I really love doing it! But in 2018, it was just a little bit more than all of this. I was invited to give two trainings in the Belgian company D. Cloostermans-Huwaert NV, and it was more than just fun and hard work.

Cloostermans is a privately owned company for six generations now, originally founded in 1884 located in Hamme (Belgium). On its website, the company describes itself as being “specialised in customised and innovative turnkey project solutions. Machines are Engineered to order. All project aspects can be provided in house: mechanical and electrical engineering, manufacturing, assembly and integration/testing.”

Nothing special, you should think.

During my teaching sessions, I quickly learned that it is in the DNA of the company to bring different opinions together, and this is supported by the CEO, Ms. Hilde Cloostermans, with whom I had some interesting conversations about project management (of course!), but also about books, our kids and the real important things in life! What a company spirit!

### First, the Project Managers

The first training was given to a group of project managers with an interest and experience in managing projects. All of them were rather young (relatively speaking), enthusiastic people, experienced in managing projects, with an affinity for numbers and with an open mind, eager to learn. An experience it was...

I explained the good-old PERT technique (Programme Evaluation and Review Technique), and took a look

behind the scenes of the technique (diving into the statistical details). While I was explaining why it could possibly work for the Cloostermans projects, and why it could fail, people were thinking out loud how they should adapt PERT to their own situation. How nice!

### Then, the Engineers

Only a few months later, the same training was given to the technical engineers. Again, I met a group of smart people, skilled in the engineering job, with not too much affinity with the project management discipline, but eager to understand how their colleagues - these strange project managers - think about their projects. Of course, the whole idea was that both groups - project managers and engineers - should learn to understand each other much better. And it magically worked!

I again talked about PERT/CPM, risk analysis, project control, and much more, and showed them why it could be relevant to the company. One of the engineers said this: “I’m not a project manager, so I’m not so interested in doing it myself, but now I know better why the project managers keep telling me that planning and risk analysis is important”. Someone else said: “It’s not my cup of tea, but I think I will understand them [the project managers] much better than before”. Again, that’s the spirit!

### Why I teach...

A few weeks after the training, the organiser of the two workshops, Michiel De Backer, sent me an email saying: “I have seen some PERT Gantt charts going around, and I believe that our team has now a more quantitative mindset of managing projects. They even extended your methodologies with some Cloostermans-specific features”.

That’s why I love teaching so much!



Picture time after the second training at Cloostermans (January, 2018)

# Library



# Academic publishing

## Quality control using a peer review mechanism

**“The literature laureate of this year has said that an author can do anything as long as his readers believe him. A scientist cannot do anything that is not checked and rechecked by scientists of this network before it is accepted.” - Sune Bergström**

In academic publishing, the goal of peer review is to assess the quality of articles submitted for publication in a scholarly journal. Before an article is deemed appropriate to be published in an internationally recognized journal, it must undergo a process to check and recheck its quality, known as a peer review process.

### The peer review process

Articles in peer-reviewed and high-ranked journals are written by academics or professionals who are experts in their field and have knowledge of the latest advances in the literature. Their academic expertise is characterized by articles showing novel results based on a sound methodology that has been reviewed by other experts from the field. They can be distinguished from the popular and sensational articles by the accurate details on their methodology and proven results that are statistically analyzed and/or empirically validated. As an author of such an article, you must undergo the following process:

- The author of the article must submit it to the journal editor who forwards the article to experts in the field. These field experts share a similar academic experience as the author and are therefore considered as the author's peers.
- The reviewers have to evaluate the quality of the submitted manuscript by checking the accuracy of the research and assessing the validity of the methodology used.
- The reviewers summarize their findings in a written response to the journal, accepting the article, suggesting revisions when appropriate, or proposing a rejection if the article lacks validity and rigor.
- The author receives a written response with a final evaluation [accept/revision/reject] and in case of

no rejection get the option to adapt their work to the wishes and needs of the reviewers.

It should be noted that the importance of the peer review process cannot be underestimated. It is an essential and critical part of the functioning of the scientific community, of quality control, and the self-corrective nature of science. To that respect, the non-peer reviewed articles are nothing more than a way to spread some ideas to a bigger audience, which is an essential goal of research. But only a peer review mechanism has the necessary component of the essential quality control of research.

### Life as an author

One of the first papers we have written about Statistical Process Control is an excellent illustration of how hard a peer review process can be, but also how it finally results in a much more improved version of the initial manuscript. Our paper has been initially submitted in January 2012, and three additional revisions were necessary, leading to literally almost 100 extra pages of material and terra bytes of additional data to run new tests, before it could be accepted. Finally, the paper has been accepted in the third revision round in June 2014 under the title "Setting tolerance limits for statistical project control using earned value management" ([www.or-as.be/blog/spc2014](http://www.or-as.be/blog/spc2014)).

This process is often unknown or not well-understood by practitioners and non-academics who write articles in the more business-oriented journals. Despite the high relevance of these business journals, it is interesting to know that every academic paper is the result of years of hard work, literally months of testing on fast computers using a sound and proven methodology, additional months to years of working on the revisions and of course also a little bit of luck. Every little detail matters and the smallest ambiguity can lead to a rejection. There's no need to mention that we are proud on the outcome.

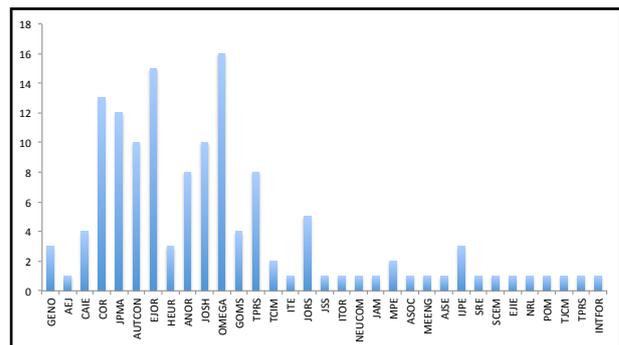
In the reference lists at the end of this book, you find a full list of mainly peer reviewed papers, but also non-peer reviewed articles and book chapters as well as some books in the field of dynamic scheduling written at the Operations Research & Scheduling (OR&S) group, with a clear focus on baseline scheduling, risk analysis and project control.

## Life as a reviewer

The life as a reviewer might look easier than as an author, but nothing is what it seems. The peer review system relies on the integrity of the authors, editors and reviewers, and each may behave unethically in the competitive world of science. Therefore, each review should be carried out with the utmost care, and involves a serious evaluation and fair judgement of the quality of the submitted work before a final suggestion can be forwarded to the editorial board of the journal. More often than not, the work you evaluate as a reviewer is right in the middle of your own expertise, and can therefore be seen as a competition for your own work in progress, or at least as a good inspiration for novel ideas.

At the OR&S groups, we promote a transparent and fair peer review by sharing and discussing our suggestions in team. As an example, in a period of somewhat more than two years (2013 - 2015), the OR&S team has evaluated 135 submissions for more than 30 international journals, and each review has been carried out by at least two team members individually and the final evaluation has possibly been corrected afterwards during a team meeting where everybody - not only the field experts - can contribute. This way, it is believed that the process has the maximum degree of fairness towards the authors, and it is hoped that this fair process bounces back to our research group in an equally fair way when we act as an author.

In the picture to the right, the number of peer reviewed manuscripts evaluated during that period is shown (the journal names are abbreviated).



The number of reviews at OR&S  
(Academic years 2013 - 2015)

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## Distributing academic research and scholarship

**“That is part of the beauty of all literature. You discover that your longings are universal longings, that you're not lonely and isolated from anyone. You belong.” - F. Scott Fitzgerald**

Below you find a list of mainly peer reviewed (i.e. checked and rechecked) papers, but also non-peer reviewed articles and book chapters as well as several books in the field of dynamic scheduling, with a clear focus on baseline scheduling, risk analysis and project control, but also with extensions to project contracting, workforce scheduling, and more.

### Peer reviewed international articles

Vanhoucke, M. and Coelho, J., 2021, "An analysis of network and resource indicators for resource-constrained project scheduling problem instances", *Computers and Operations Research*, To Appear. [doi: 10.1016/j.cor.2021.105260]

Song, J., Martens, A. and Vanhoucke, M., 2021, "Using Earned Value Management and Schedule Risk Analysis with resource constraints for project control", *European Journal of Operational Research*, Under Submission.

Servranckx, T., Vanhoucke, M. and Aouam, T., 2021, "Practical application of Reference Class Forecasting for cost and time estimations: Identifying the properties of similarity", *European Journal of Operational Research*, To Appear.

Barrientos-Orellana, A., Ballesteros-Pérez, P., Mora, D., González-Cruz, M. C. and Vanhoucke, M., 2021, "Stability and accuracy of deterministic project duration forecasting method in Earned Value Management", *Engineering, Construction and Architectural Management*, To Appear.

Milička, P., Šůcha, P., Vanhoucke, M. and Maenhout, B., 2021, "The bilevel optimisation of a multi-agent project scheduling and staffing problem", *European Journal of Operational Research*, To Appear.

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# Epilogue



**“Alone we can do so little. Together we can do so much.” - Helen Keller**

## Epilogue

### Credits

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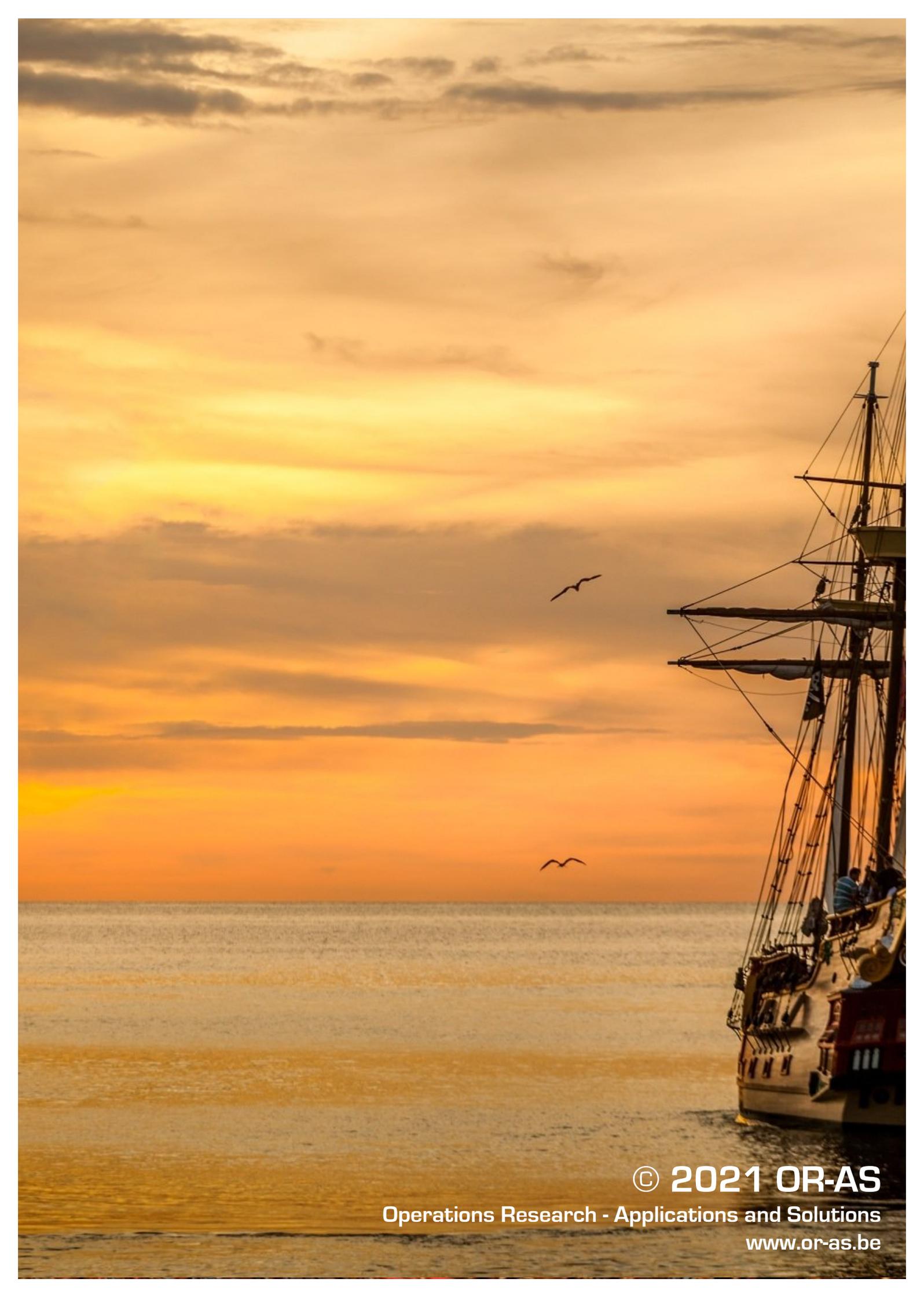
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### Update

This book will be updated on a regular basis to add the new topics and themes we will investigate. If you want to receive a message when an update is available, connect through @mariovanhoucke.

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