

Software engineering in industrial practice

Module 10: Large-Scale Project Management Christian Schmitz Speaker





Christian Schmitz Division Manager Would you like to stay in **touch**? Feel free to contact me on **XING** or **LinkedIn**, keyword: Lecture SEIP



Unsere Regeln für ein optimales Online-Meeting



- Bitte schalte das Micro stumm, wenn du nicht sprichst
- Bitte Kamera einschalten 😊
- Wenn möglich, Headset benutzen
- Bei Fragen bitte Hand heben über den Button
- Oder alternativ im Chat kommentieren

- Mute your mic when not speaking
- Please turn your camera 🙂
- Please use a headset if possible
- Use "raise hand" button for questions
- Alternatively, comment in chat



Software Engineering Workflow & Lecture Software Engineering in Industrial Practice (SEIP)







Large-Scale Project Management Planned process

15:10 - 15:25	Enterprise Agile Frameworks
15:25 - 15:40	Economic efficiency of IT projects
15:30 - 16:30	Cost estimation and calculation of major projects



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Large-Scale Project Management

Enterprise Agile Frameworks

SCRUM at a glance

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Overview of different enterprise agile frameworks

- SAFe and LeSS are the predominantly used enterprise agile frameworks
- Both frameworks are widely used
- Both frameworks have been implemented successfully or could be implemented incorrectly

SAFe at a glance (1/2)

Summary

C Scaled Agile, Inc

- Several roles (and maybe hierarchies)
- Big room meetings with multiple teams
 - PI-Planning,
 - Inspect & Adapt (Review, Retro)
- Team Meetings (with one team only)
 - Refinement
 - Iteration Planning Review, Retro
- Same Cadence with 5 Iterations and with Exploration, Integration, Deployment in an Iteration and PI
- Overall Consistent Approach on more levels e.g., Design Thinking or Portfolio Management (see next image)

SAFe at a glance (2/2)

LARGE SOLUTION PORTFOLIO FULL OVERVIEW ESSENTIAL • DE BUSINESS AGILITY DE 🖉 Organizational Agility Enterprise Government PORTFOLIO **Portfolio Flow Operational Value Streams** Big Data Value Stream Management Epic NFRs Solutions 00 Portfolio . Backlog Lean Vision Portfolio Strategic Lean Budgets Coordination KPIs Portfolio Themes Vision Epic Enterprise Management Owners Architect Guardrails **Development Value Streams** đ OKRs LARGE SOLUTION Solution Demo Solution Train Flow WSJ Ň Ĩ Enterprise Solution Coordinate and Deliver Solution Mgmt Solution R Compliance Solution Roadmap Pre-Plan ariable Architect Fixed MBSE Delivery STE SOLUTION Set-Based \mathbf{Y} SOLUTION INTENT : Solution Train TRAIN ♦ Supplier ♦ Backlog AI ESSENTIAL **ART Flow** Business Owners **Continuous Delivery Pipeline** Solution **Customer Centricity** Shared WSJF AGILE RELEASE TRAIN Services Ň Product Mgmt 2 VF Agile Product Delivery System Architect Continuous Continuous Continuous Solution CoP Lean UX NFRs Deployment Exploration Integration Context ~ ART Release on Demand Design Thinking Backlog RTE *6 Cloud **Team Flow** System De C_it. Agile Teams System Team Sec Team and Technical Q 17 Product Agility Owner SAFe Scrum NFR Measure DevOps Built-In & Grow Team ≣ Quality Scrum Master / Team Coach Backlogs **PI Objectives** Architectural Runway SAFe Team Kanban **Business & Technology** Leffingwell, et al. C Scaled Agile, Inc. Continuous I_I Core Values SAFe SPC Lean-Agile

Principles

Select SAFe configuration

Implementation

Roadmap

Learning

Culture

Mindset

Lean-Agile

Leadership

LeSS & LeSS Huge at a glance (1/2)

Summary

- LeSS does not talk much about hierarchies or roles
- Big room meetings with multiple team
 - Planning 1
 - Refinement
 - Retro jumpsuit
 - Review
- Team meetings (with one team only)
 - Planning
 - Refinement
 - Retro
- Focus on technical Software Development (not Portfolio)

LeSS & LeSS Huge at a glance (2/2)

Comparison chart of selected enterprise agile frameworks

	Kosten / Aufwand								
	Kategorie	Kriterien	LeSS	Nexus	Spotify	Scrum @ Scale	SAFe		
		Von wem und wann?	Craig Larman, Bass Vodde, 2005	Ken Schwaber, 2015	Henrik Kniberg, Anders Ivasson, 2012	Jeff Sutherland, 2018	Dean Leffingwell, 2011		
	Allgemeine Info	Dokumentation	Dokumentation LeSS.works		labs.spotify.com	scrumalliance.org	scaledagileframework.com		
		Basis (Scrum/ Kanban,)	Scrum	Scrum	offen für alle agilen Methoden	Scrum	offen für alle agilen Methoden		
j.	Referenz /	Referenzkunden	Telekommunikation, BMW, UPS, > 30	keine bekannt	Spotify, ING, Deutsche Telekom, Rewe Digital, >4	SAP, Intel, Comcast, Allianz	Hoch / viele >60		
S oder	Einsatz	Teamgröße	LeSS: bis ca. 8 Teams; LeSS Huge: ab ca. 8 Teams	3 bis 9 Teams	Squad < 8, ab 4 Squads	Team SoS: 2-5 ; SoSoS 6-25 Mtarbeiter SoS <45; SoSoS <225	ab 7 Teams		
e, LeS	Einsatz	Unterstützt standortüber- greifendes Arbeiten	anwendbar Co-located	anwendbar	nicht anwendbar (Huddle Rooms)	anwendbar	anwendbar aber nicht empfohlen (Big Room Planning)		
k: SAF		Verbindlichkeit/ Strukturierungsgrad	niedrig bis mittel	mittel	mittel bis hoch	hoch	hoch		
newor		Abhängigkeiten zwischen den Teams	LeSS: möglich; LeSS Huge: möglichst keine Abhängigkeiten	möglichst keine Abhängigkeiten (oder minimieren)	möglichst gering	offen => eigene Governance möglich	viele Abhängigkeiten möglich => wird gesteuert		
gile Frar	Bewertung	Artefakte	Inkrement, 1 Produkt Backlog, n Sprint Backlog, m Area Back- logs, 1 DoD	Nexus Sprint Backlog, Product Backlog, Increment	Squad, Backlog, Roadmaps	Scrum Backlog, SoS Impedimemnt Backlog, Release Plan	Program Board, PI Objectives		
em besten A		Events und Zeremonien	Overall Retro, großes und kleines Refinement, Planning 1 (which), Planning 2 (how), Daily (öfter mal woanders teilneh- men), Communities	Nexus Sprint Planning, Nexus Sprint Retro, Nexus Sprint Review, Nexus Daily Scrum	Scrum Kanban Meetings, Hackdays, Quartalsstudie, Chapter Meeting, Gilde Treffen	Scrum (Daily,); Scaled Daily Scrum, Exec. Meta Scrum, PO Team Release Planning	PI Planning, SoS, Syst. Demo; (epic, feature, story) Dependancy Map Enabler		
nach d		Kosten / Lizenz / Schulung	agiles Mindset	gering	abhängig von aktuellem kulturellen Umfeld	Lizenz: durchschnittlich; Change: hoch; Training: niedrig	mittel bis hoch		
r Suche I	Tinfilhoung	Was muss "ontop" getan/ entschieden werden?	Mindset organisatorische Änderungen	Agiles Mindset	ggf. Agile / Spotify Mindset Schulung	Change Mgmt: Transformation, Setup; FW: Fehlende Vorgaben in SoS entwickeln	Implementation Roadmap durchlaufen: v.a. Schulung für alle, LACE Team bevoll- mächtigen		
Aut de		Organisationskultur Ist-Bild => Wunschbild	-	-	Agiles Mindset, willing to fail, failure culture	Startup	eher geeignet für traditionelle Unternehmen, für alle offen		
		Risiken und Hindernisse	-	-	kein Blick auf das Product Backlog als Ganzes durch zu viel Autonomie	Change Aufwand hoch, Freiheit => Chaos?	kann fehlinterpretiert werden und über bestehende Organisation übergestülpt werden ohne viel zu ändern		
	3esonderheiten	Besonderheiten LeSS Test, Area Product Owner, Travelers		Integration Team	Autonomie Squads, Huddle-rooms, Fehler-Kultur, Gemeinschaft von Hierarchie, ständige Motivation, langfristige Ziele bei Squads	ganze Organisation, methodische Governance im SoS, nicht FW ; leichtgewichtig	Selfassessment (Essential SAFe, Lean Enterprise, Dev Ops Health,), Imple- mentation Map, geeignet für (Weiter-) Entwicklung von Programmen (mehrere Produkte)		
		Rollen (extra)	-	Integration Team	Agile Coach	Chief Product Owner	Release Train Engineer, Pro-duct Manager, SPC, System Architect, Business Owner, System Team		
	Strukturierungsgrad / Verbindlichkeit								

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Large-Scale Project Management

Economic efficiency of IT projects

Agenda

Software engineering in industrial practice Project management: economic efficiency

- 1. Basics and definitions of terms
- 2. Economic efficiency of IT projects
- 3. Literature

Agenda

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Basics and definitions of terms

IT efficiency

IT investments

- IT plans and IT projects often represent major investments in the company.
- The often non-transparent benefits are offset by high costs.
- Limited IT budgets require an objective prioritization of these investments.

IT organization

- Profitability is a key issue for every company.
- The IT organization is seen as a cost driver.
- In contrast to "traditional" corporate functions, IT used to be seen as a "black box" for decision-makers, but since the rise of digital business models, the benefits of IT have become clearer.

Objective

- Measurable, complete and sustainable criteria as a basis for business decisions
- Ongoing monitoring of target achievement

Economic efficiency through IT

Benefits through IT

IT costs

Agenda

Software engineering in industrial practice Project management: economic efficiency

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Economic efficiency of IT projects

The phases of an IT project

Neglected or unconsidered cost drivers

Planning

- Feasibility study / business case
- Rough concept / requirements analysis
- Make or buy decision
- Technical concept / IT concept, design

Frequently neglected cost drivers

- Waste disposal
- Data backup
- Data migration

Economic efficiency of IT projects

Cost allocation for IT projects

Economic efficiency of IT projects

Development

Benefit

Planning

Costs

Costs and benefits over the software life cycle

Operation

The balance of all cash flows (costs and benefits) over the service life of an application results in the net benefit.

Replacement

Net benefit

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Literature

- Bernotat J., Stein J., "10 Tipps & Tricks zum Business Case ", GPM-Magazin PMAktuell, 2/2007, S. 43-47
- Stein J, "Mit dem Business Case Wirtschaftlichkeit von Projekten nachweisen – der Business Case sichert den Erfolg von IT-Projekten", GI/ACM-Regionalgruppe, Karlsruhe, 25.09.2007
- Brugger R., "Der IT Business Case", Springer, 1. Aufl., 2005

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Large-Scale Project Management

Cost estimation and calculation of major projects

Agenda

Software engineering in industrial practice Project management: Effort estimation

- 1. Basics and definitions of terms
- 2. Bottom-up estimate (expert estimate)
- 3. Top-down estimation (use case points)
- 4. Literature

Agenda

Software engineering in industrial practice Project management: Effort estimation

1. Basics and definitions of terms

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Control of programs

When projects become "big"!

What is the difference between a project and a major project?

- Project and major projects have the same definition
 - A project is a "project that is essentially characterized by the uniqueness of the conditions as a whole, e.g. objectives, time, financial, personnel or other limitations, project-specific organization.¹
- Projects and major projects differ "only" in the characteristics of some criteria, usually the high quantity of
 objectives and/or delivery results (specification) and the scope in terms of time and costs.

1. Definitions: GPM (E-Book) | PM3 | DIN 69901-5 (DIN, 2009c)

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TERMIN

SPEZIFIKATIONE

PROJEKT-

KOSTEN

Control of programs

Internal and external interfaces and service providers must be considered in the same way as dual clients and other (agile) roles!

sind besonders dann schwierig, wenn sie sich auf die Zukunft beziehen." Tasks Perform Experience Calibrate (Re)estimate

Basic definition of the term

"Prognosen

Cost estimates are always based on practical experience and intuition

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Efforts

measure

expenses

The limits of intuition are reached in large-scale projects

- Expert estimates are based on the experience of experts: Each element of the parts list is individually estimated by the expert
- Expert: At least 3 x a comparable task/project carried out by yourself
- Assumption: a typical (small) project takes 9 months:

Project A	Project B	Project A'	Project C	Project A"		
1	I	I	I	I	I	
0	9	18	27	36	45	months
4					>	
Expert after 3	.75 years					

• Assumption: a major project or program lasts 3 years:

Project A	Project B	Project A'	Project C	Project A''	
۱ <u>ــــــــــــــــــــــــــــــــــــ</u>	3	6	9	12	 years
Expert after 15	5 years 😊				

Basic definition of the term

Estimation databases with FSM (Functional Size Measurement) overcome the limits of intuition in large projects

Basics and definition of terms

The effort model¹ structures project activities according to task categories → All activities in a project can be clearly assigned!

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Bottom up is the preferred estimation strategy

Estimation strategies

Top-Down

• Overall estimate of the project effort using **mathematical algorithms** based on the functional requirements. Generally only used by msg for plausibility checks.

- The expenses of each expense item are determined separately and **added together** to form the total project expenses.
- In a typical msg project, we take a bottom-up approach.

Overview of estimation methods

Algorithmic	Comparison	Key figures	Expert
methods	methods	methods	estimates
COCOMO	Analogy method	Multiplier	Individual estimation
Function Points		methods	Delphi method
Use Case Points		Percentage meth.	Estimation test / PERT method
 Calculation of expenses by formula, usually empirically proven Based on measurable product variables, e.g. LoC, requirements or specification Partly time-consuming, but good results 	 Makes reference to development projects carried out No measurable product variables such as LoC required Recalculations of old projects necessary 	 Similar analogy method, but you need measurement data from completed projects 	 If possible, use the analogy method Initial estimation of new requirements using expert knowledge
	Top-Down		Bottom-Up

Agenda

Software engineering in industrial practice Project management: Effort estimation

1. Basics and definitions of terms

2. Bottom-up estimate (expert estimate)

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Expert estimates are a widely used method for all types of for all types of development projects

- Systematic bottom-up estimation by experts based on their wealth of experience
- Estimated items are derived as expense items on a projectspecific basis
- Often the only viable option for "inhomogeneous" or highly customized projects
- Different variants of expert estimation differentiate the system and scope of expert involvement:
 - Single estimate: A single expert determines the estimated values for a specific expense item
 - Delphi method: Several experts carry out their estimates anonymously and separately from each other
 - Estimation retreat: Several experts estimate in a joint estimation workshop

Expert estimate -Detailed information: Comparison of the variants

Individual estimate

- A single expert determines the estimated values for a specific expense item.
- Accuracy depends largely on the experience of this expert.
- High responsibility for one person
- One-sided assessment of expenses and uncertainties

Delphi method

- Several experts carry out their estimates anonymously and without coordination among themselves.
- Merging of the estimate by the PL if necessary in iterations in the event of (large) deviations.
- Correction options for the estimated figure without losing face
- No peer pressure

Estimation exam / Planning Poker

- Several experts estimate "online" as part of a joint workshop.
- Immediate consolidation of expenses and plausibility checks
- Content discussions in the event of major deviations
- Group agrees on expense per estimate item
- Becoming aware of risks
- Consistent level of information in the team

Pragmatic but

slightly imprecise

Reliable but very time-consuming

Better than average values but also timeconsuming

PREFERRED ESTIMATION METHOD FROM MSG1

The effort estimation consists of several steps

Activity	Result
 Breakdown into tasks (parts list) Estimate tasks individually several independent estimates 	Net expense
+ cross-sectional effort as %-experience values	Gross expenditure
Valuation with calculated hourly rates, + FP risk + warranty	Total budget
 Plausibility check through Project plan and employee mountains Relationship between the project phases Comparison projects 	Plausible budget
Target / actual comparison	Budget projection

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Everything that requires effort ...

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Expense items (estimated item)

- All project-related activities
- The list of all expense items is given in the parts list
- Not every expense item has to be a 1:1 work result
- Expense items do not have to match the subsequent planning units

We estimate expenses in person days (PT) of 8 h

- It must be possible to complete 1 person day (PT) in 8 hours (!) not in a 10-hour day (or 24-hour day ☺).
- We do not estimate set-up times separately, i.e. each effort figure also includes time for drinking coffee, short breaks, reading emails, tidying up desks, etc.

Planning and estimation view

1 PJ 1600 Ph 1 PJ = 10 PM

Cost and estimation uncertainty are determined for each estimation item

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Total expense := estimate + expense risk

What does "fixed price" mean?

Definition of fixed price:

Delivery ...

- ✓ of a defined **result**
- at a certain point in time &
- ✓ for a fixed price

Problems of the fixed price (waterfall process model)

 Dynamic changes result in a "specification decay" of the defined event

e.g. changes ...

- of the market
- the technology
- of the product
- of the environment
- the stakeholder / contact person
- the company's priorities
- ...
- Customer & service provider do not work together indirectly
- Bureaucratic effort for contract amendments due to the abovementioned changes

How does an "agile fixed-price project" work?

1. Vision/goal	 Joint definition of the overall objective Identification of an EPIC as a reference EPIC (high priority, early development) 	
2. Reference EPIC	 Complete break-down into user stories & estimation (e.g. with Planning Poker & Story Points) based on one / several reference user stories -> Customer & service provider together Story points are converted into costs 	Expire p 3% of th applies - little de
3. More EPICs	 Joint estimation based on the reference EPIC using Magic Estimation 	Spe
4 . More EPICs	 Specification & estimation is created shortly before the functionality is implemented: "Changes", "Experience" & "Feedback" are incorporated promptly, so that the specification decay is low & less conceptual WASTE is created 	100% co correctly estimatio - but only - less pla

Practical example: Structuring a parts list

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Practical example: Project controlling of the individual backlog items / program increments / sprints

- As part of the changeover to an agile approach, central management was significantly strengthened ("ART team").
- Progress and budget controlling takes place at sprint and PI level as well as globally. A number of automated evaluations are already available or are currently being developed. Measured KPIs include:
 - Team performance
 - Adherence to the sprint scope and the planned effort
 - Budget consumption, burn-down charts, regular residual cost estimates

The key figures of the expense model are used to check the plausibility of an estimate

Kennzahlenplausibilisierung								
Kennzahlen		Schätzung	Erfahrungs Aufw (~1σ-Β von	swerte aus Modell ereich) bis	Median	Kommentar		
SP	/ PI	0%	8%	28%	19%	Detailspezifikation fertig bzw Rest nach Aufwand bis v1.0		
KON	/ UM	13%	9%	25%	17%			
REA	/ UM	53%	35%	65%	52%			
INT	/ UM	34%	17%	40%	32%			
INT-BUGFIX	/ UM	8%	5%	19%	13%			
PK	/ PI	45%	15%	40%	28%			
PK-PL	/ PI	16%	6%	18%	12%	PL & Entwicklungsleitung, daher mehr als normal		
PK-PM	/ PI	3%	2%	6%	4%			
PK-CD	/ PI	12%	4%	12%	8%			
PT	/ PI	17%	3%	10%	6%	DevOps sind mit eingeplant (zusätzliche Resource)		
PN-EIN	/ PI	1%	2%	7%	4%			
QS	/ PI	0%	3%	8%	5%	wurde nicht separat geschätzt, sollte aber abgedeckt sein		

- We define a key figure as any quotient from two task categories of the expense model. This means that each key figure has a clear meaning in terms of content, which is a prerequisite for the company-wide use of key figures.
- The key figure plausibility can be plausilized,
 - all expense categories were comprehensively covered in the estimate.
 - the distribution of the workload appears to make sense based on experience from previous projects.
- The empirical values for percentage distribution only serve as guidelines, as each project is individual. However, major deviations should at least be questioned and justified.

As an initial guide to team size and project duration is Brook's rule of thumb

"The man-month as a measure of the amount of work is a dangerous and misleading myth. The term wants to make us believe that agents and months are interchangeable factors"

Fred Brooks in "The myth of the man-month"

The cost estimate is checked for plausibility using an employee checked for plausibility

- Calculate area, here: 30 time months (ZtM)
- 1 ZtM = 0.8 BM due to public holidays, training, illness, meetings, etc.
- Here the conversion from ZtM to PM results in: 30 * 0.8 = 24 PM
- Does this match the cost estimate?

From the number of employees and the total effort the project duration can be determined

In this example, the total expenditure of 104 PM was spread over 14 months: Maximum 11 employees, average 8.9 employees or 7.4 PM, team structure and maximum team size are reasonable.

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The budgeting of the project includes - in addition to the expenditure other parameters

Parameters		Method	Experience value
All parameters	•	Imputed specifications	Concrete or % of gross expenditure
Hourly rate		Determined by management; according to qualification or mixed hourly rate	
Gross expenditure * hourly rate		Determine average hours / day Calculate overtime	8 - 9 h / day
Travel expenses		Number of trips * average costs	up to 14 %
Fixed price risk surcharge			10 - 25 %
Warranty			3 - 10 %
Other costs		Acquisition costs for hardware, software per shopping list	Only "pass-through" or with surcharge

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Summary of the principles

Concrete	 As many expense items as possible are specifically estimated; as few as possible are determined by percentage mark-ups.
Estimation uncertainty	 The estimation uncertainty is recorded for each estimated expense item. However, only one expense figure is then recorded for each estimated item, which forms the basis for subsequent project planning and costing.
Expense sheet	• The result of the estimate is documented in the so-called expense sheet.
Completeness	 The expense sheet is used to ensure that the figures are complete and plausible.
Premises	 You often come up against limits (because something is not clearly specified, because something is unclear, because something has been forgotten). In this case, you formulate premises for the estimate, which become the basis of the offer.

Agenda

Software engineering in industrial practice Project management: Effort estimation

- 1. Basics and definitions of terms
- 2. Bottom-up estimate (expert estimate)
- 3. Top-down estimation (use case points)
- 4. Literature

Motivation for the use of use case points

- Top-down estimation method for quick estimation of projects
- Overall estimation of the project effort with the help of **mathematical** algorithms
- Estimation based on **functional requirements** (use cases)
- Generally only used to check the plausibility of the expert estimate
- But also enables quick (rough) budget estimates
- The more estimates are made in an environment, the more accurate the method can be

Development of functional size measurement

Source: Lother, M.; Dumke, R.: Points Metrics - Comparison and Analysis. in: Dumke et al (Eds.): Current Trends in Software Measurement - Proceedings of the 11th IWSM. Proceedings of the 11th IWSM, Montréal, Shaker Verlag. Aachen. pg: 228-267. 2001; supplemented by S. Frohnhoff, sd&m AG Top-down estimation (use case points)

The Use Case Points (UCP) method is based directly on a use case-based specification and is very easy to apply

The UCP method requires a technical determination of size

Method is unsuitable,

if the scope of system adaptations is poorly captured by use cases, z. e.g. for technical levels in which the technicality (A-factor) changes only slightly

4. literature

Software engineering in industrial practice Project management: Effort estimation

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Literature

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Kontakt

Christian Schmitz +49 (170) 9241329 christian.schmitz@msg.group msg systems ag Robert-Bürkle-Straße 1 85737 Ismaning

+49 89 96101-0 +49 89 96101-1113

info@msg.group

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