IT Solutions with Software Engineering in Practice - Effort and cost estimates in large scale development projects

Course at TU Darmstadt, May 4th 2015, Thomas Engeroff

Automotive Financial Services Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities Automotive Financial Services Food Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities Automotive Financial Services Food Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities Financial Services Food Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities Automotive Financial Services Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities Automotive Financial Services Food Insurance Life Science & Healthcare Public Sector Telecommunications & Media Travel & Logistics Utilities

TECHNISCHE UNIVERSITÄT DARMSTADT

msg systems

.consulting .solutions .partnership

Thomas Engeroff

- 2008: degree in information technology from the university in Darmstadt (Diplom)
  - major in software engineering and minor subject economics
- in parallel to studying: commercial software development and consulting
- 2008 – 2011: at sd&m/Capgemini as a software engineer → project manager
  - Research department: effort estimation, in particular use case points (1 year)
  - afterwards part of telco & media department
- since 2011: Senior Project Manager at msg systems ag
  - part of telco & media department
  - current project: Project manager at Vodafone - responsible for network rollout and integration at major public places in Germany (Sport arenas, airports, train stations, fairs,…)

off the job…

my cats…

hobbies: „refurbishment of my home“ and motor biking

last “real” vacation…

AGENDA

1. Basics and Definitions
2. Bottom-Up Estimation (Expert Estimation)
3. Top-Down Estimation (Use Case Points)
4. Literature

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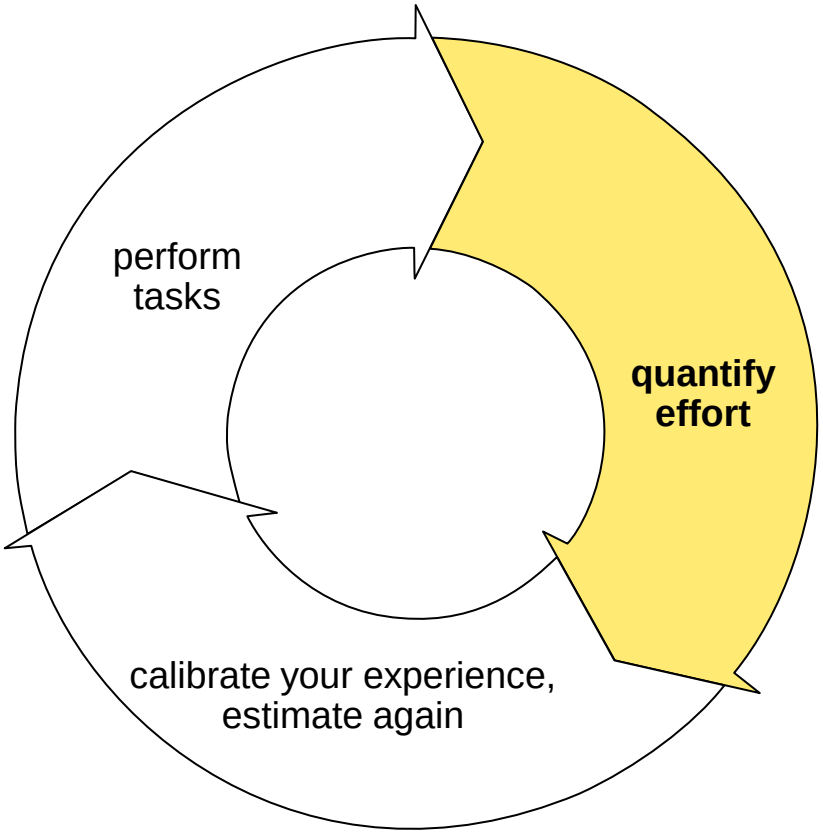
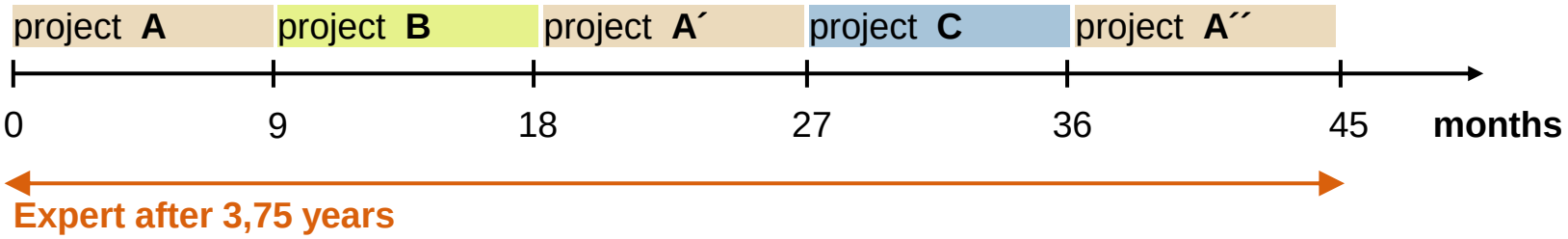
Estimation is always based on real experience and intuition

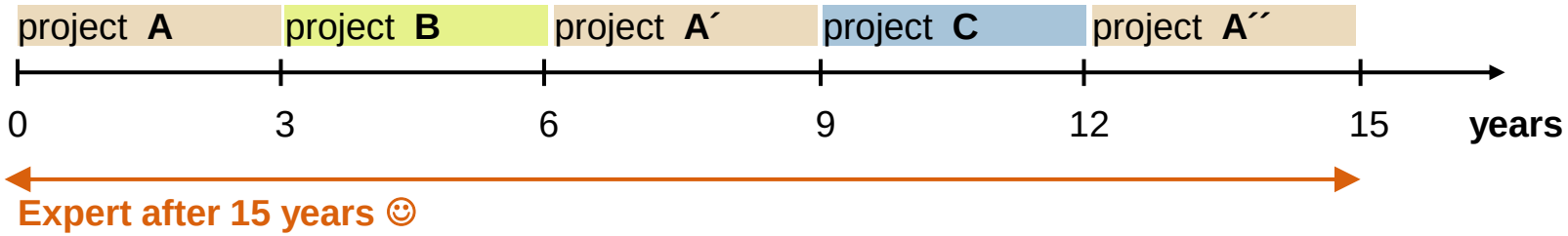


Limits of intuitive estimation in large scale projects

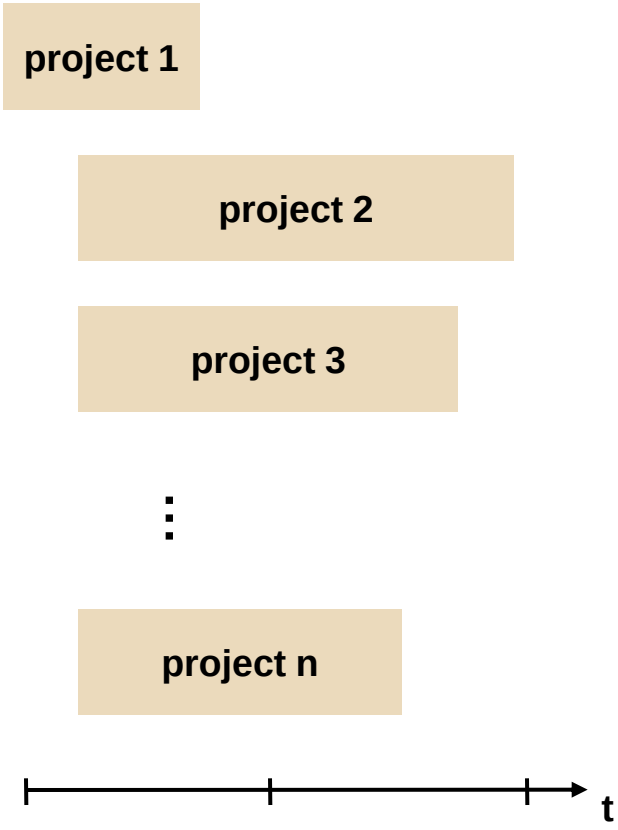
- Expert estimates are based on experiences of experts:
  Each element of a bill of material will be estimated by an expert
- “Definition of an expert”: Has executed comparable task at least 3 times
- Assumption: **a typical (small) project** lasts 9 months:

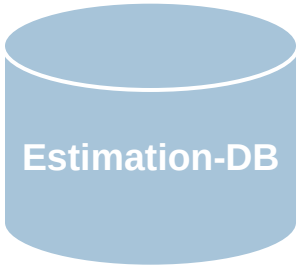


- Assumption: a **Large Scale Project** resp. **Program** takes 3 years:



Estimation databases for FSM (Functional Size Measurement) solve the limits of intuition in large scale projects



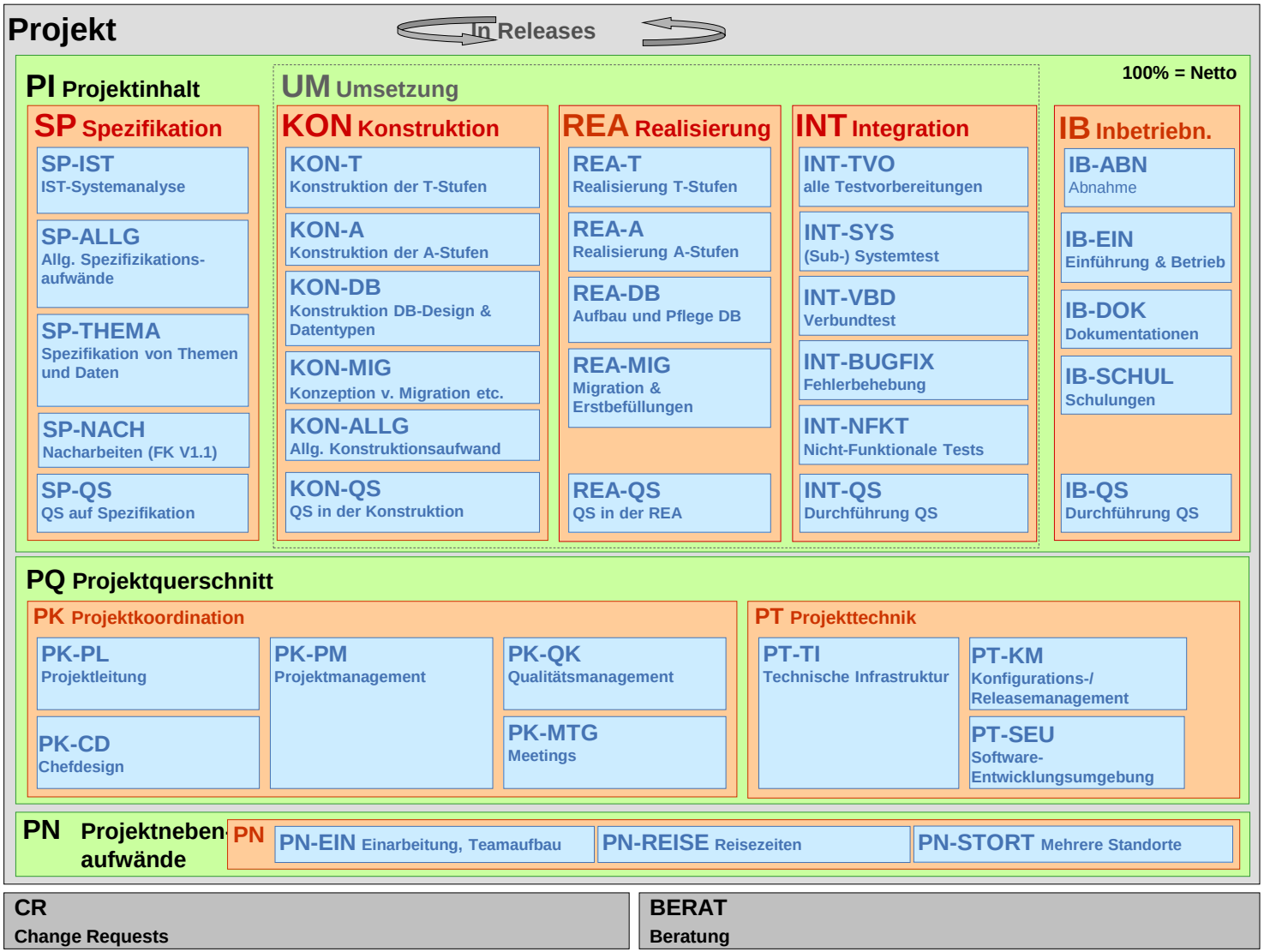


Standardization required for:

- **size (FSM)**
- **complexity**
- **environmental factors**

project n + 1

Account system categorizes tasks (example: sd&m AG)



Layer 0,
for statistics and reports

Layer 1

Layer 2

Every project estimates and records its efforts on one of this layers .
Projects larger than 15 PM have to use layer 2, for smaller projects it is optional.

→Layer 1 & 2 define task categories

Projekt

In Releases

100% = Netto

PI Projektinhalt

SP Spezifikation

- **SP-IST** IST-Systemanalyse
- **SP-ALLG** Allg. Spezifizikations-aufwände
- **SP-THEMA** Spezifikation von Themen und Daten
- **SP-NACH** Nacharbeiten (FK V1.1)
- **SP-QS** QS auf Spezifikation

UM Umsetzung

KON Konstruktion

- **KON-T** Konstruktion der T-Stufen
- **KON-A** Konstruktion der A-Stufen
- **KON-DB** Konstruktion DB-Design & Datentypen
- **KON-MIG** Konzeption v. Migration etc.
- **KON-ALLG** Allg. Konstruktionsaufwand
- **KON-QS** QS in der Konstruktion

REA Realisierung

- **REA-T** Realisierung T-Stufen
- **REA-A** Realisierung A-Stufen
- **REA-DB** Aufbau und Pflege DB
- **REA-MIG** Migration & Erstbefüllungen
- **REA-QS** QS in der REA

INT Integration

- **INT-TVO** alle Testvorbereitungen
- **INT-SYS** (Sub-) Systemtest
- **INT-VBD** Verbundtest
- **INT-BUGFIX** Fehlerbehebung
- **INT-NFKT** Nicht-Funktionale Tests
- **INT-QS** Durchführung QS

IB Inbetriebn.

- **IB-ABN** Abnahme
- **IB-EIN** Einführung & Betrieb
- **IB-DOK** Dokumentationen
- **IB-SCHUL** Schulungen
- **IB-QS** Durchführung QS

PQ Projektquerschnitt

PK Projektkoordination

- **PK-PL** Projektleitung
- **PK-CD** Chefdesign
- **PK-PM** Projektmanagement
- **PK-QK** Qualitätsmanagement
- **PK-MTG** Meetings

PT Projekttechnik

- **PT-TI** Technische Infrastruktur
- **PT-KM** Konfigurations-/ Releasemanagement
- **PT-SEU** Software-Entwicklungsumgebung

PN Projektneben-aufwände

PN

- **PN-EIN** Einarbeitung, Teamaufbau
- **PN-REISE** Reisezeiten
- **PN-STORT** Mehrere Standorte

CR
Change Requests

BERAT
Beratung

Exercise: How to book the following tasks?

- Design phase: Team meeting (status report), 2 hours.
- Functional specification phase: Team meeting - agreement on screen layouts, 30 minutes
- Implementation phase: Developer does not find bug in module A. PM and Developer together search for 4 hours.
  Which task category is used by developer? Which one by PM?

What is a cost model? Basics and goals

- The cost model for software development projects defines an **obligatory structure** for effort estimates, effort documentation and recalculation.
- The structure is defined by abstract **task categories** covering any task within a software development project.
- Thus, the cost model defines a **common language** within a development project.
- The task categories define both the effort categories and furthermore the **account system** for booking of project efforts.
- Thus, we build the preconditions for
  - making projects **comparable**
  - enhance **QA** and **proof of completion** for estimates and recalculations
- Comparability is a precondition for **systematical learnings** and achieving empirical metrics and estimation ratios.

What are the tools of the cost model?

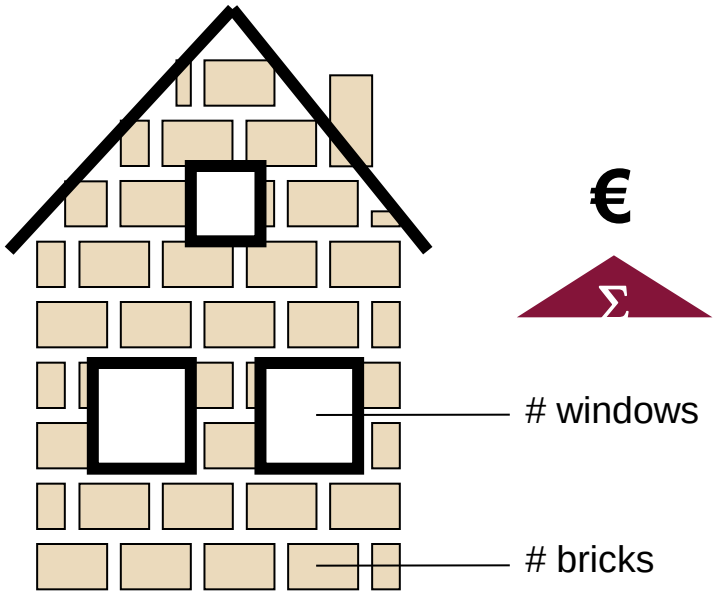
- Consistent **effort categories** and the corresponding **account system.**
- **Effort estimation template** for documentation of the cost estimation.
- **Post calculation** template along account systems to record the actual effort by project closing.
- **Estimation ratios** based on empirical effort data to validate estimates.

Further common terms…

fixed price charge	Agio for guaranteed fixed price to account for business risks (false assumptions, contractual penalties, forgotten contract demands by estimation, …
warranty charge	Agio for warranty claims after acceptance (e.g. bug fixing)
net effort	• immediate effort for development of project artefacts (Projektinhalts (PI)) • without crossfunctional effort (Projektquerschnitt (PQ)) or indirect project efforts (Projektnebenaufwände (PN))
gross effort (Bruttoaufwand= Gesamtaufwand)	**Total effort of project delivery** • without fixed price charge • without warranty charge It is the sum of • Projektinhalt (PI), i.e. specification, realization, … • Projektquerschnitt (PQ), i.e. project management • Projektnebenaufwand (PN), i.e. job training

We distinguish Bottom-Up und Top-Down estimation methods

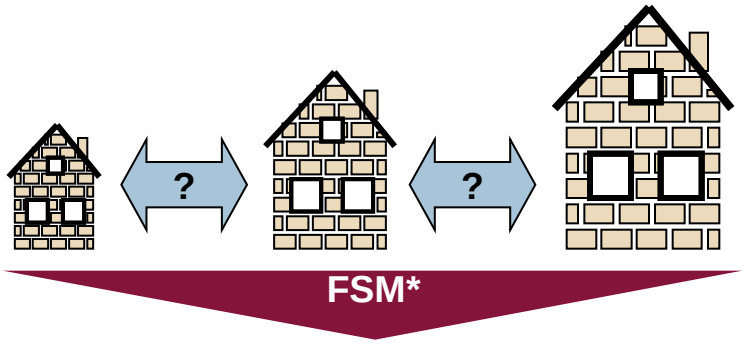
Bottom-Up



1 specification

2 implementation

Top-Down



f (x)

€

* FSM : functional size measurement

Bottom up is the preferred estimation strategy

estimation strategies	
Top-Down	Total estimation of project effort by **mathematical algorithms** based on functional requirements. *Normally used for validation of bottom-up estimates by msg.*
Bottom-Up	Effort of each task of the project is calculated separately and **summarized** to gather total project effort. *“Standard approach within msg…”*

Overview of estimation methods

algorithmic methods	comparison methods	ratio methods	estimation by experts
COCOMO Function Points Use Case Points • estimation by formula, in general empirically proofed • based on measurable features, i.e. LoC, requirements or specifications • partial costly but good results	**analogy method** • Links to development projects realized in the past • No measurable quantities such as product LoC needed • Necessary recalculations of completed projects	**multiplier methods percentage methods** • Similar to analogy method, but you need data from completed projects	**single estimate Delphi method estimation workshop** • if possible draw on to analogy method • first-time estimate of new requirements by expertise
Top-Down			**Bottom-Up**

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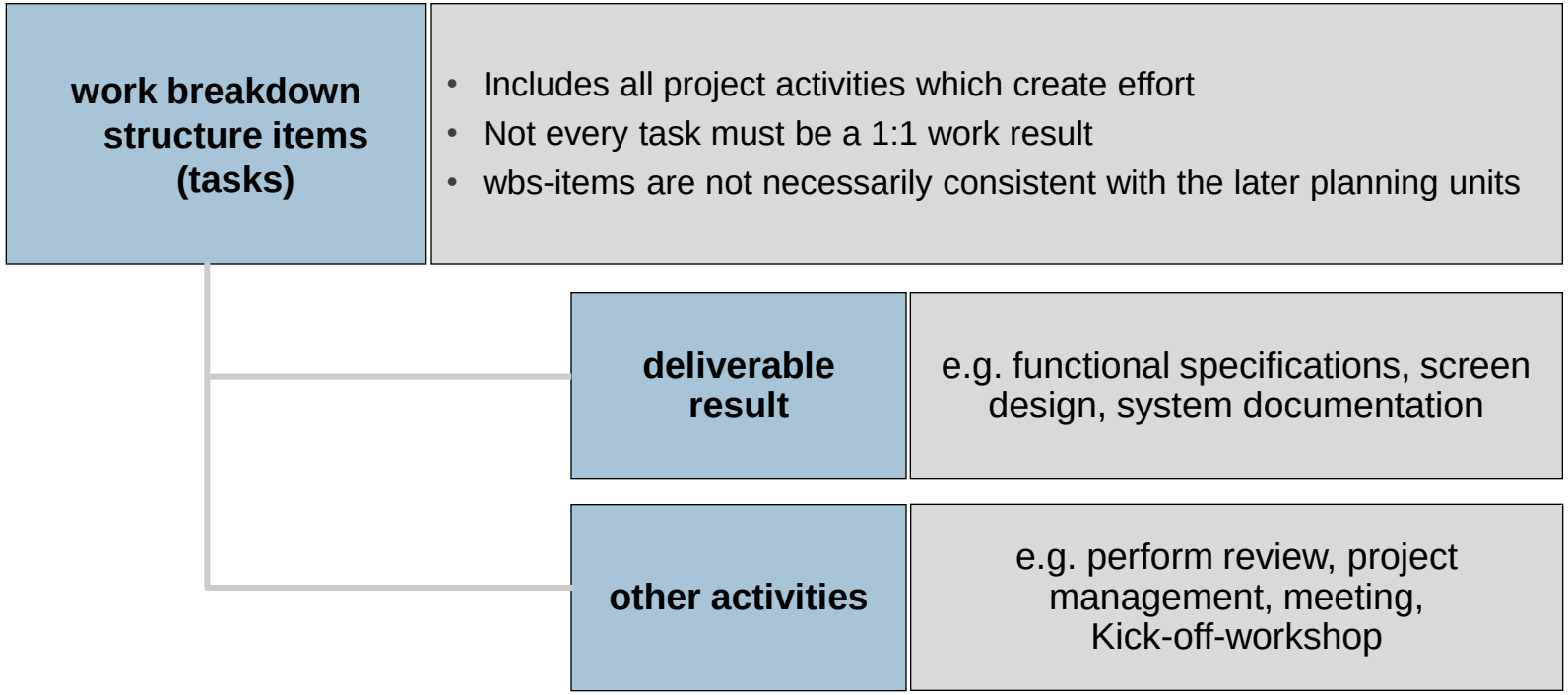
Expert estimates are a common method for all types of development projects

- Systematic bottom-up estimate of experts, based on their experience
- For "nonhomogeneous" or highly customized projects often the only viable way
- Different variants of the expert estimation differentiate systematic approach and extent of the involvement of experts:
  - **Single estimate**:
    A single expert determines the estimated values for a particular task
  - **Delphi method**:
    Several experts conduct their estimate anonymously and separately
  - **Estimation workshop**:
    Several experts estimate in a joint estimation workshop

Steps to create a cost estimation

Step	Result
• work breakdown structure (wbs) – list of all necessary tasks • estimate each task	net effort
+ cross-functional efforts as empirical values (percent values)	gross effort
Rating by calculated hourly rates + fixed price charge + warranty charge	total budget
Validate by: • project plan and staffing curve • project phase ratios • comparison to similar projects	feasible budget
target-performance comparison	budget projection

Anything that makes effort, …



We estimate efforts in man-days (PD) à 8 h

- Effort of one person (1 PD) day has to be delivered within 8 hours (h) – not within 10-hour-day (or 24h-day ☺).
- We do not separately estimate setup time

Planning and estimation View

1 PD	8 h	
1 PW	40 h	1 PW = 5 PD
1 PM	160 h	1 PM = 20 PD

1 PY	1600 h	1 PY = 10 PM

Estimated effort and estimation uncertainty is determined for each task

total effort := estimate + estimation risk	
estimate [h, PD]	Approach to determine the effort and the estimation risk by using an estimation method. **In any case, the basis for an estimate are fixed requirements or at least assumptions about project content and conditions documented as premises.** The result of the estimate is the total effort of the project in hours or person days (in contrast to project calculation: €).
estimation risk [h, PD]	**x% of estimation uncertainty.** The estimation uncertainties will not be allocated by each task. The definition depends on the judgment of the responsible bid manager.

The work breakdown structure records all estimation items in PD and assigns task categories according to the accounting systems

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best practice

Aufgabenkategorie	Thema/Komponente	Aufwandsposten	Schätzung	Aufwandsrisiko	Gesamtaufwand
SP-ALLG		Initialisierung: fachliche Workshops, Themenabgrenzung, Spez-Pattern, etc.	4	1	5
SP-ALLG		Einleitung, Glossar, Überblick, Redaktion etc.	3	1	4
SP-THEMA	Stammdatendialoge	Spez Dialog: Pflege Skilehrer	1	0,5	1,5
SP-THEMA	Stammdatendialoge	Spez Dialog: Pflege Kurstypen (Art, Übungen, Preise etc.)	1	0,5	1,5
SP-THEMA	Stammdatendialoge	Spez Dialog: Pflege Stammdaten Skischule	1	0,5	1,5
SP-THEMA	Kursplanung & -abwicklung	Spez Dialog: Verfügbarkeit Skilehrer	2	0,5	2,5
SP-THEMA	Kursplanung & -abwicklung	Spez Dialog: Skikurse anlegen/pflegen	2	0,5	2,5
SP-THEMA	Kursplanung & -abwicklung	Spez Dialog: Kursbuchung	4	1	5
SP-THEMA	Kursplanung & -abwicklung	Spez Dialog: Fakturierung	2	1	3
SP-THEMA	Druckausgaben	Rechnung	1	0,5	1,5
SP-THEMA	Druckausgaben	Übersicht über alle Kurse	1	0,5	1,5
SP-THEMA	Druckausgaben	Übersicht zu einem Kurs	1	0,5	1,5
SP-NACH		Erstellen Version 1.1	2	1	3
SP-QS		Qualitätssicherung Spez	2	1	3
KON-ALLG		Vorbereitung IT-Konzept: Nutzungskonzept/EHB für Access, Pattern IT-Konzept,	5	2	7
KON-A	Stammdatendialoge	Kon Dialog: Pflege Skilehrer	0,5	0,5	1
KON-A	Stammdatendialoge	Kon Dialog: Pflege Kurstypen (Art, Übungen, Preise etc.)	0,5	0,5	1
KON-A	Stammdatendialoge	Kon Dialog: Pflege Stammdaten Skischule	0,5	0,5	1
KON-A	Kursplanung & -abwicklung	Kon Dialog: Verfügbarkeit Skilehrer	0,5	0,5	1
KON-A	Kursplanung & -abwicklung	Kon Dialog: Skikurse anlegen/pflegen	1	0,5	1,5
KON-A	Kursplanung & -abwicklung	Kon Dialog: Kursbuchung	1	0,5	1,5
KON-A	Kursplanung & -abwicklung	Kon Dialog: Fakturierung	1	0,5	1,5
KON-A	Druckausgaben	Rechnung	0,5	0,5	1
KON-A	Druckausgaben	Übersicht über alle Kurse	0,5	0,5	1
KON-A	Druckausgaben	Übersicht zu einem Kurs	0,5	0,5	1
KON-QS		Qualitätssicherung IT-Konzept	1	0	1
REA-A	Stammdatendialoge	Pflege Skilehrer	1	1	2
REA-A	Stammdatendialoge	Pflege Kurstypen (Art, Übungen, Preise etc.)	3	1	4
REA-A	Stammdatendialoge	Pflege Stammdaten Skischule	1	1	2
REA-A	Kursplanung & -abwicklung	Verfügbarkeit Skilehrer (Planung)	2	0,5	2,5
REA-A	Kursplanung & -abwicklung	Skikurse anlegen/pflegen (Planung)	3	0,5	3,5
REA-A	Kursplanung & -abwicklung	Kursbuchung	7	2	9
REA-A	Kursplanung & -abwicklung	Fakturierung	4	1	5
REA-A	Druckausgaben	Rechnung in Word	4	1	5
REA-A	Druckausgaben	Übersicht über alle Kurse (Access Bericht)	1,5	0,5	2
REA-A	Druckausgaben	Übersicht zu einem Kurs (Access Bericht)	1,5	0,5	2
REA-DB		Aufbau DB	3	1	4
REA-QS		Codereviews	2		2
INT-TVO		Testfälle & Testkonzept erstellen	5	1	6

Additional charge for cross functional tasks have to be estimated step by step or by percentage estimation

Cross functional tasks	Estimation	Empirical value
all tasks	**as precise as possible**	**in % of net effort**
project management	team member x project duration 1 PM on 7 team members	10 - 20 %
chief design	team member x project duration	
quality assurance	step by step estimation of each task	10 - 25 %
software development environment, technics	depends on project: estimate set-up and maintenance separately	5 - 25 %
travel time	number of travels x mean travel time	up to15 %
meetings, presentations, etc..	number of meetings x participants x time scheduled	up to15 %
team trainings	step by step estimation	

In the effort estimation template different parts of the total effort are visible

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best practice

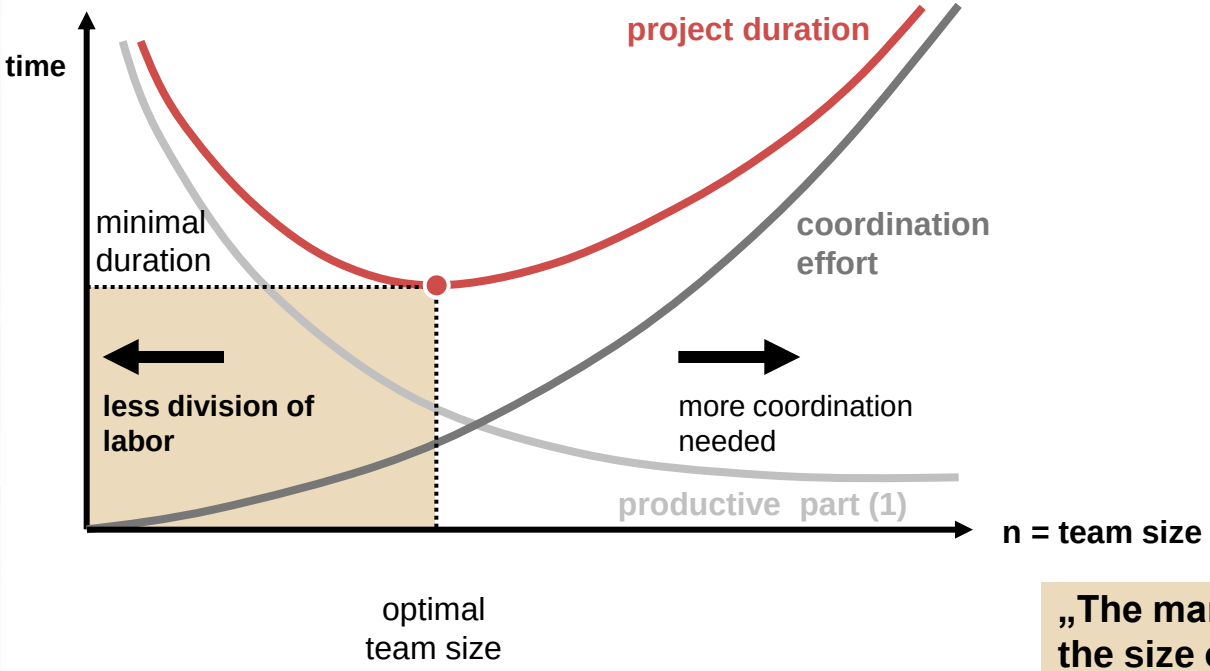
task			effort [PD]
function 1			100
function 2			300
function 3			200
net effort			600
project management	15%	90	
quality assurance	15%	90	
team training	5%	30	
application management	15%	90	
travel time	7%	42	
go live support	8%	48	
cross functional effort	65%		390
gross effort			990
fixed price charge	10%		99
warranty charge	10%		99
total effort			1.188

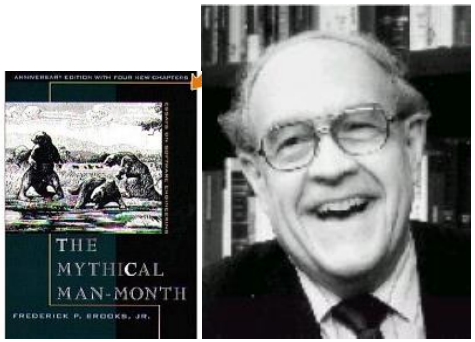
For determination of the net effort items are counted and evaluated

best practice

item type	complexity	quantity		effort per item	=	total effort
• classes	• easy • medium • complex • single case • single case	22 15 8 1 1	x	2 PD 5 PD 10 PD 25 PD 20 PD	=	44 PD 75 PD 80 PD 25 PD 20 PD
• dialogs	• easy • medium • complex • extreme	13 25 6 2		3 PD 5 PD 8 PD 18 PD		39 PD 125 PD 48 PD 36 PD
• batches • interfaces • tables • …						

Take Brooks rule of thumb for a first indication of team size and project duration





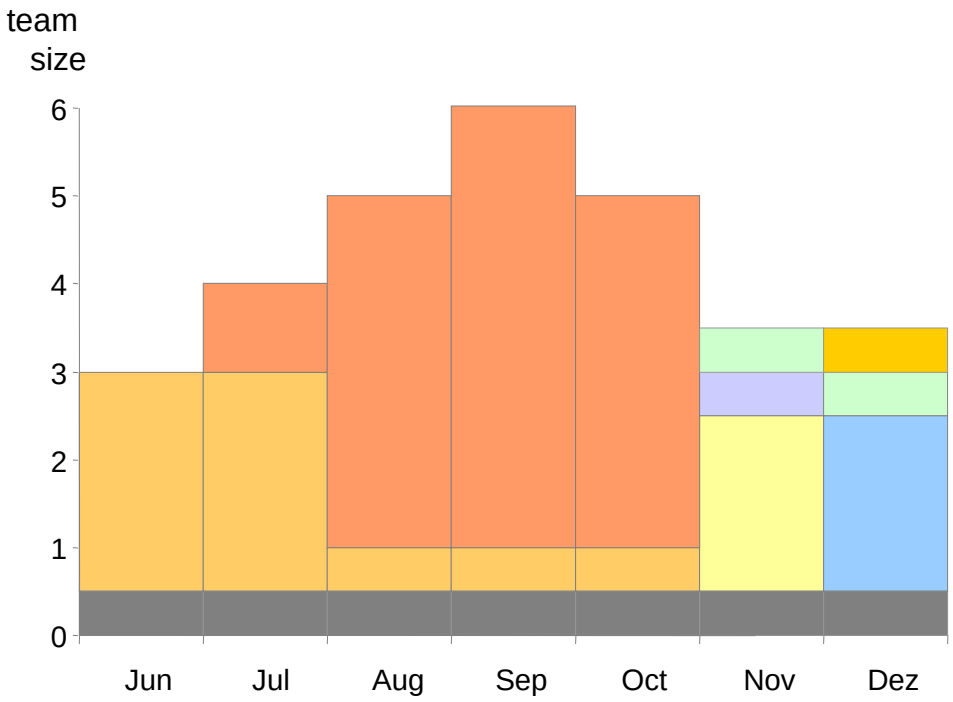
optimal team size ~ $\sqrt{\text{effort in PM}}$

„The man-month as a unit of measuring the size of a job is a dangerous and deceptive myth. It implies that men and month are interchangeable“

Fred Brooks in „The Mythical Man-Month“

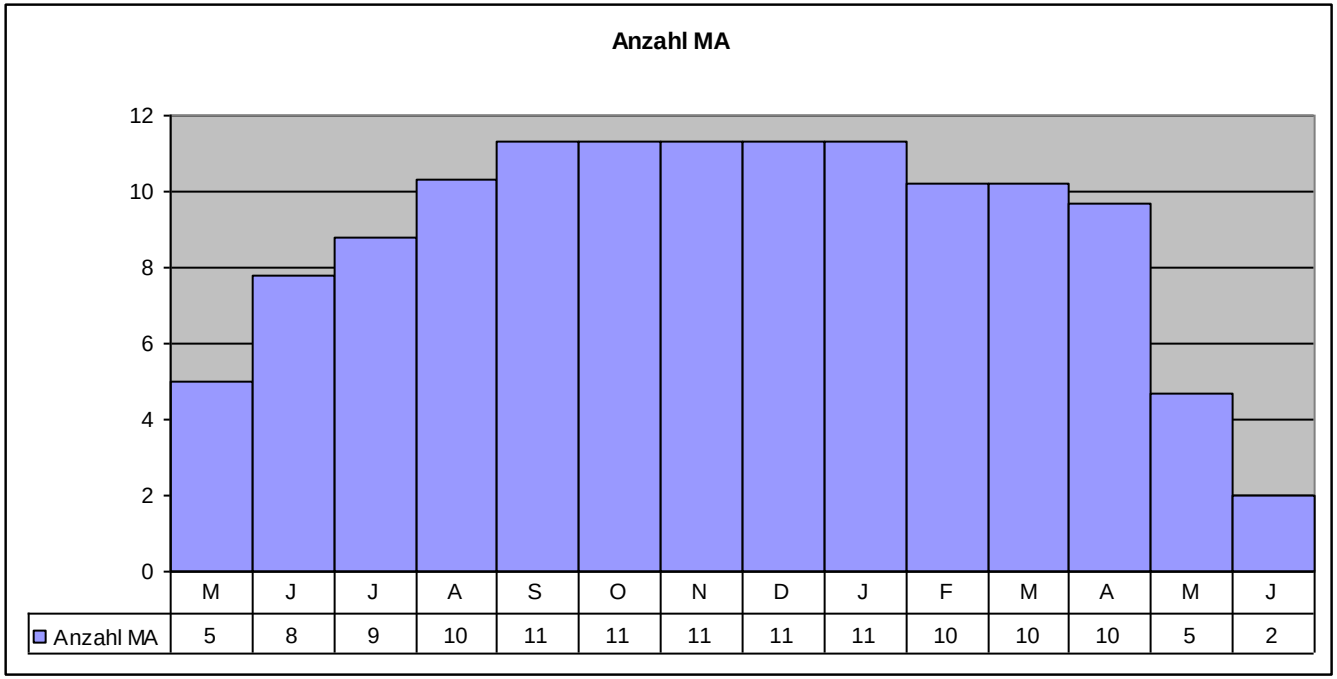
The effort estimate is cross checked by a staffing curve

- Outline the project schedule with estimated duration and team size
- Calculate area, here: 30 months total
- 1 month = 0.8 PM due to public holidays, training, illness, meetings, etc.
- This results in the conversion of month to PM: 30 * 0.8 = 24 PM
- Does this fit to the estimation?



From the staffing curve and the total effort of the project the duration can be determined

In this example, the total effort of 104 PM was distributed to 14 months: Maximum 11 people, on average 8.9 employees and 7.4 PM, team ramp up and maximum team size is reasonable.



effort [PM] (10/12)	4,2	6,5	7,3	8,6	9,4	9,4	9,4	9,4	9,4	8,5	8,5	8,1	3,9	1,7
cumulated effort	4,2	11	18	27	36	45	55	64	74	82	91	99	103	104

The budget of the project takes different parameters into account - in addition to the effort

parameter	method	best practice
all parameters	**guidelines**	**specific or % of gross effort**
hourly rate	management definition; according to skill set or blended rate	
gross effort * hourly rate	define mean hours / day calculate overtime	8 - 9 h / day
travel expenses	number of travels * mean costs	up to 14 %
extra charge for fixed price risk		10 - 25 %
warranty		3 - 10 %
other costs	costs for hardware, software via shopping list	„as is“ or extra supplement

Summary

Tangibility/Traceability

Estimate step by step as many effort items as possible; avoid percentage markups

Estimation uncertainty

Record the estimation uncertainty for all items. Note that for each item only one calculated result is used for later project planning and calculation.

Effort estimation template

The result of the estimation is documented in the so-called effort estimation template.

Completeness

The effort estimation template ensures the completeness and plausibility of the figures.

Premises

Often limits are reached (because something is not specified 100% correct, because something is unclear or because something has been forgotten).

In this case it is necessary to formulate assumptions and to integrate those into the bid.

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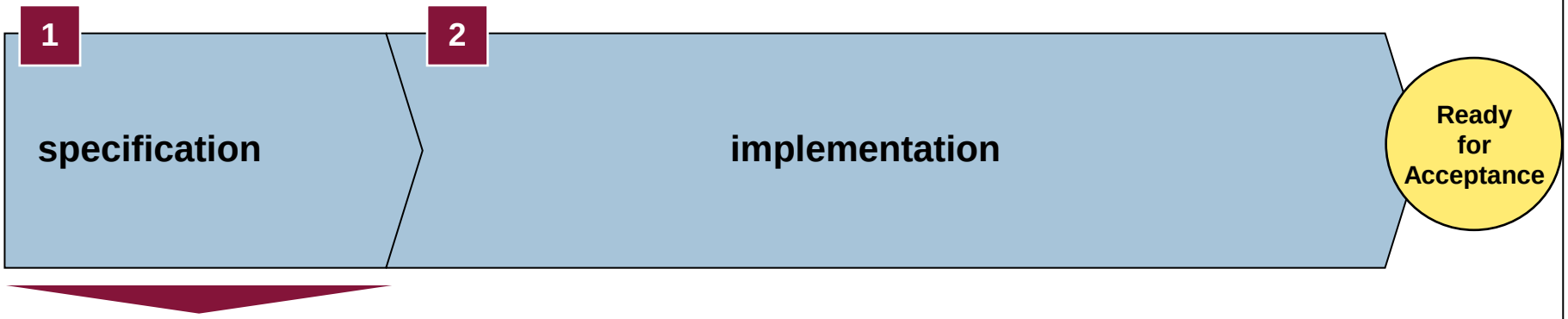
The top-down estimate is based on measurement of functional size (FSM) of the business requirements

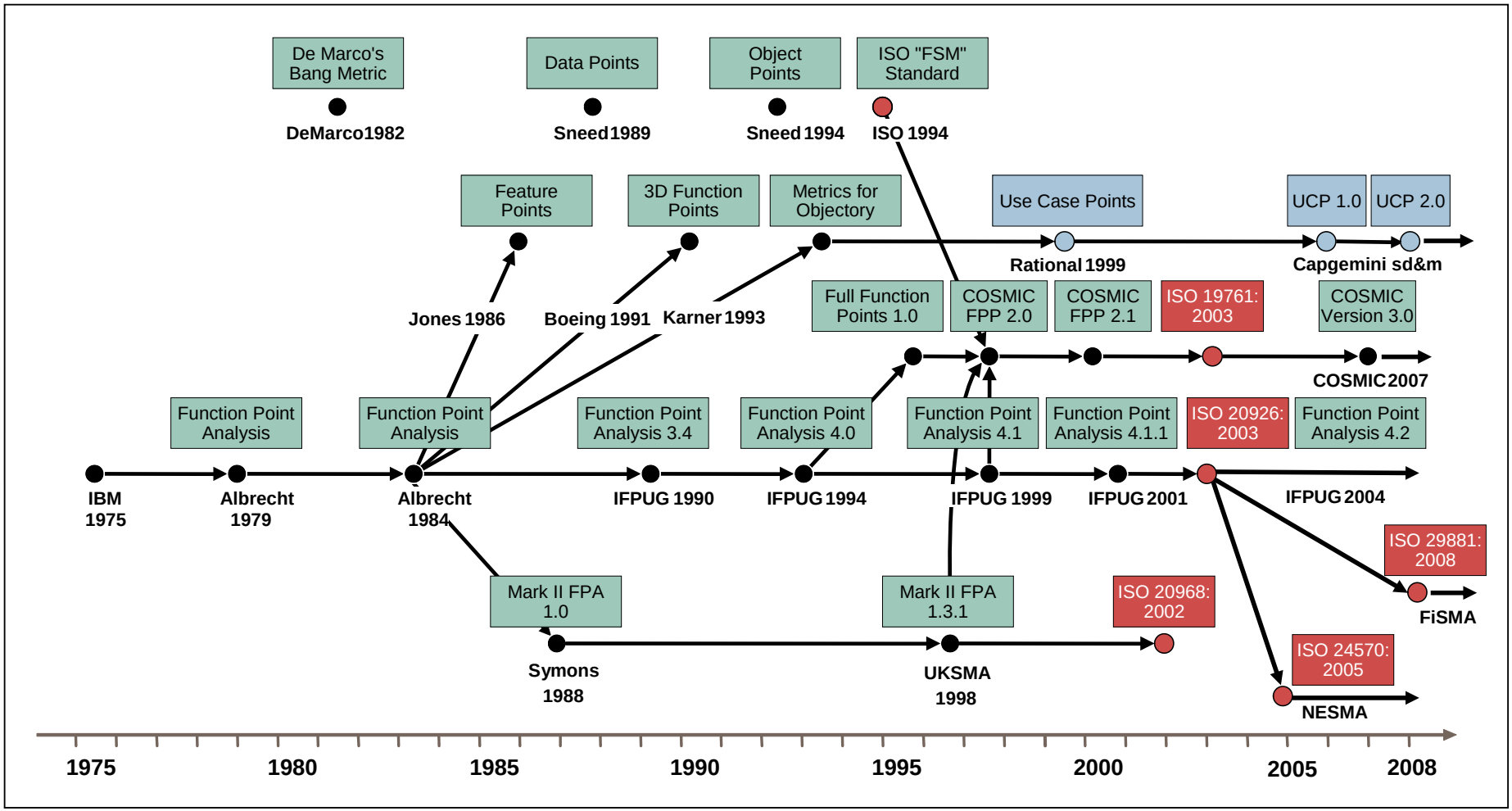
Top-Down Estimation

- Overall estimate of the total project effort using mathematical algorithms based on the functional requirements
- Assumption: comparability of project efforts for the same functional scope
- Functional size of the requirements is measured in "points"



- functional requirements
- non functional requirements

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, Montréal, Shaker Verlag. Aachen. pg: 228-267. 2001; ergänzt durch S. Frohnhoff, sd&m AG

Use Case Points (UCP) are a promising approach with application in practice

Gustav Karner

- developed UCP under the supervision of Ivar Jacobsen at Objectory AB (later on acquired by Rational)
- “Metrics for Objectory”. Diploma thesis, University of Linköping, Sweden. No. LiTHIDA-Ex-9344:21. December 1993

John Smith

- “The Estimation of Effort based on Use Cases”. Rational Software. Cupertino, CA.TP-171. October 1999
- Part of the „Rational Unified Process“ (RUP)

Documented best practice

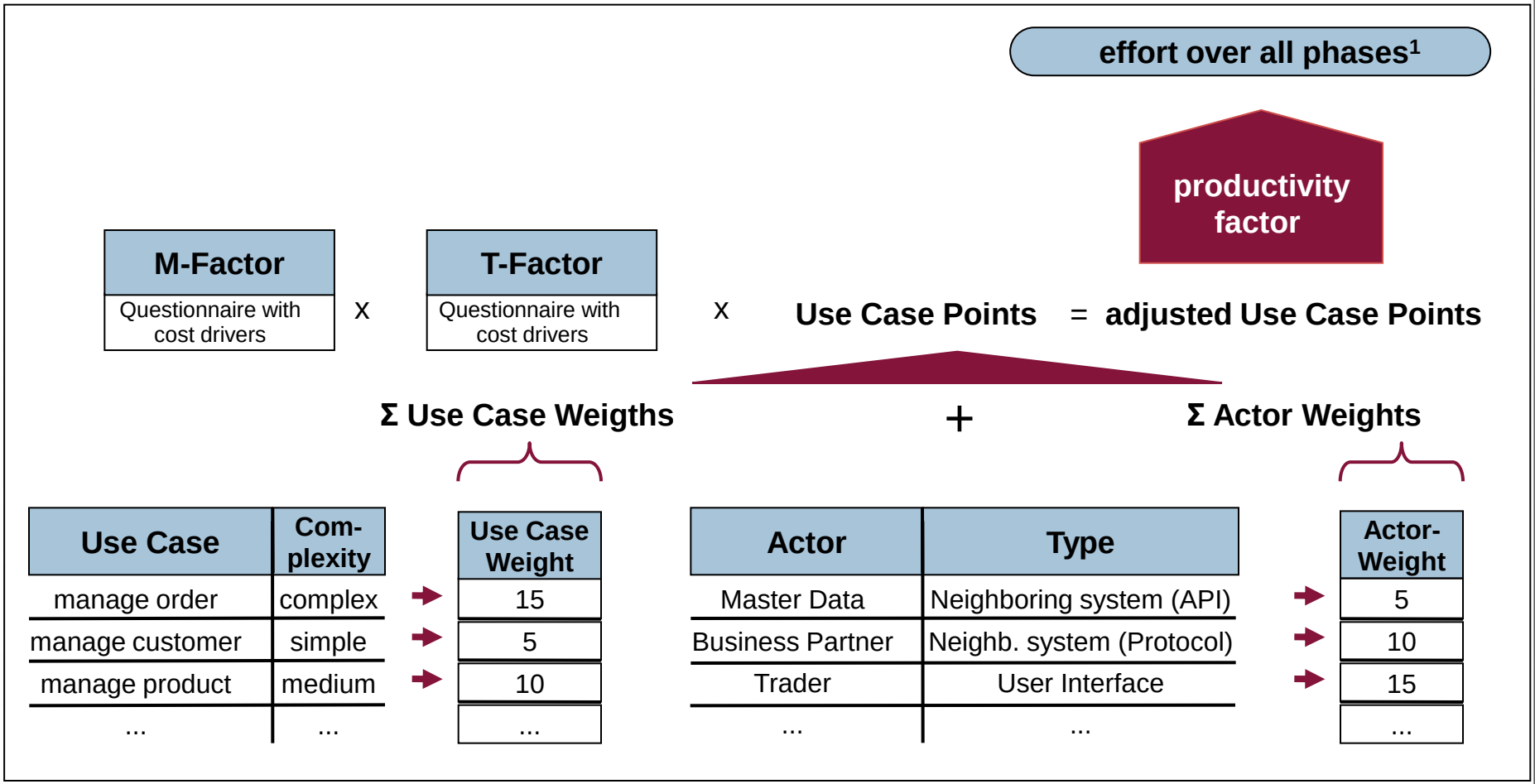
- Rational, Sun, IBM, Capgemini, msg, ...

latest tools for UML modeling integrated UCP-Tools

- Example: Sparx Enterprise Architect (Mid-Price-Tool)
- Excel-Sheet suites well ...

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

Overview UCP-Method



ABC individual analysis — calculated by standard metric (simple, medium, complex) — calculated by industry metric

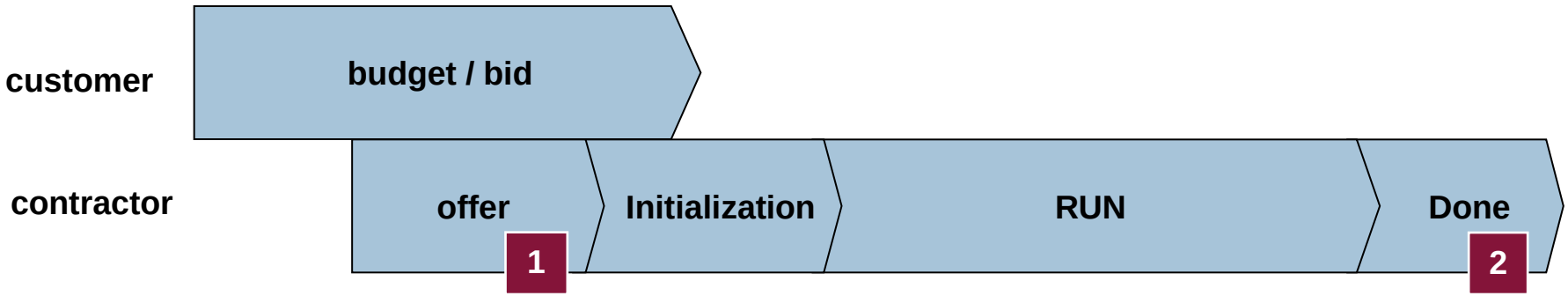
1) according to mapping on effort sheet

The extended UCP method (UCP 2.0) reduces the estimation variance to less than 20%

		UCP method (by Karner)			optimized method UCP 2.0				
Project	Actual effort [h]	UUCP	Estimated effort [h]	Devi-ation	A-Factor	T-Factor	M-Factor	Estimated effort [h]	Devi-ation
Car 1	4.824	227	6.569	36%	259	0,97	1,14	4.978	3%
Car 2	7.894	327	9.869	25%	367	1,01	1,36	8.746	11%
Car 3	7.069	177	5.366	-24%	253	1,02	1,49	6.643	-6%
Clothes	728	50	854	17%	70	0,87	0,77	811	11%
Finance 1	7.825	141	5.208	-33%	205	1,06	2,13	8.012	2%
Finance 2	3.680	124	3.730	1%	160	1,03	1,14	3.269	-11%
Finance 3	2.992	71	1.728	-42%	115	0,89	1,49	2.628	-12%
Industry 1	55.592	1.717	53.702	-3%	1.917	1,05	1,94	67.739	22%
Industry 2	7.368	221	6.221	-16%	261	1,05	1,14	5.440	-26%
Logistics 1	2.567	61	1.874	-27%	125	1,14	1,04	2.566	0%
Logistics 2	7.250	268	8.234	14%	300	1,14	1,04	6.157	-15%
Logistics 3	944	73	747	-21%	105	0,68	0,81	1.001	6%
Logistics 4	5.362	231	6.617	23%	295	0,96	0,93	4.575	-15%
Logistics 5	2.936	201	5.796	97%	241	0,97	0,74	2.981	2%
Public 1	4.804	182	5.624	17%	198	1,04	1,53	5.463	14%
Telco 1	65.000	1.395	45.905	-29%	1.503	1,17	2,00	60.638	-7%
Telco 2	2.456	170	2.088	-15%	210	0,94	0,81	2.748	12%
Telco 3	2.432	131	1.939	-20%	195	1,04	0,76	2.660	9%
Standard deviation				*± 34%*					*± 13%*

Source: sd&m AG, 2007

The UCP method is used at msg to check the plausibility of the expert estimates and to create recalculations



1 go / no go decision

- For go /no go decision the expert estimate is compared with the UCP estimate.
- The estimate is based on the inception phase, a draft specification with variable format, but use-case based.

2 project touch down

- At project closure a recalculation is performed. The actual work is compared with the UCP estimate.
- Basis of the final costing is the specification (parts list of implementation phase).

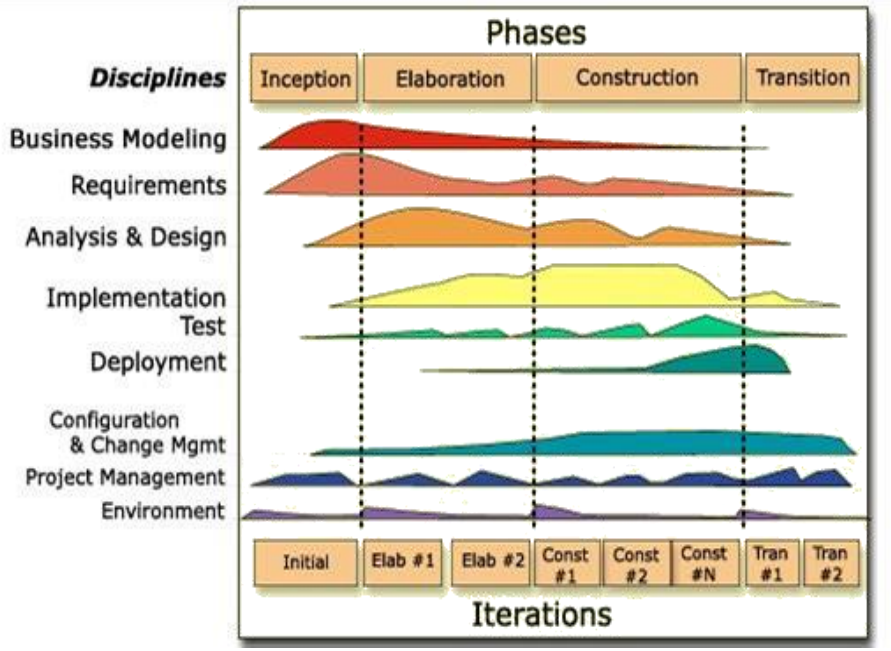
The UCP method is based on a rough specification and estimates the detailed specification and implementation phases

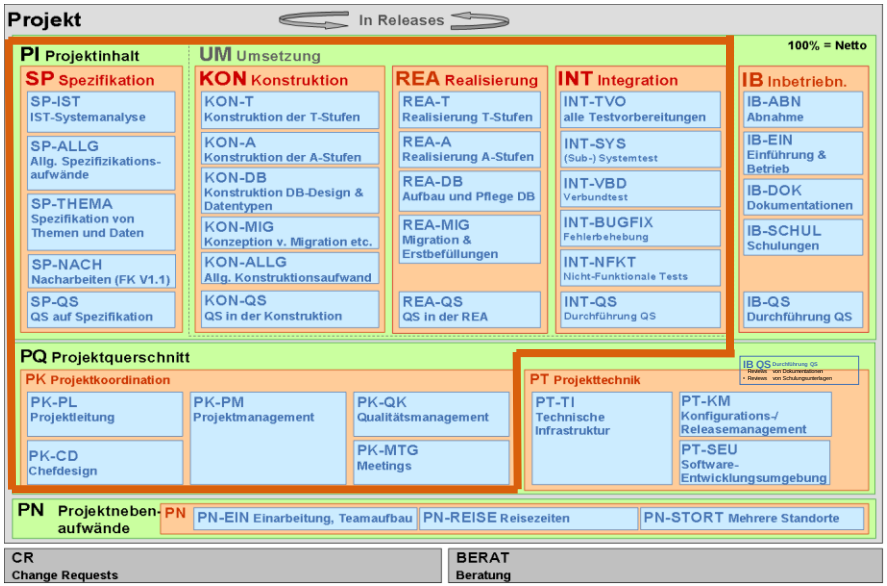
precondition

- rough specification is available (RUP: Inception)
- specification format is variable

estimation scope

- from detailed specification to system acceptance (RUP: Elaboration + Construction)
  - including QA activities
  - i.e. following **outlined** tasks in the chart of accounts[1] :



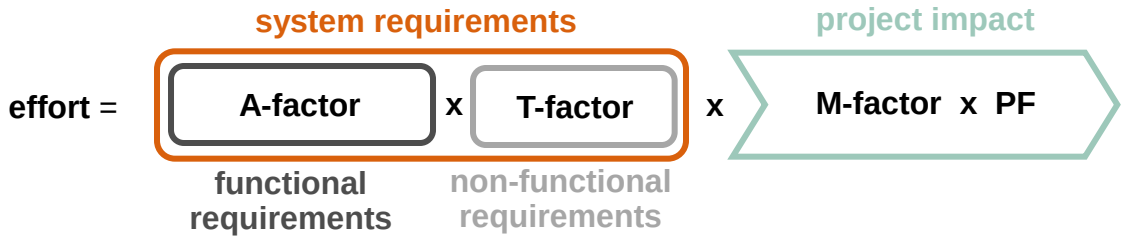


1) SP without efforts for draft specification

The UCP estimation is done in 5 steps and differentiated according to system requirements and project impact

1. classify Use Cases
2. classify actors
3. determine T-factor
4. determine M-factor
5. calculate effort

- **Use cases** describe the behavior and interaction of a system in response to the distinct request or action of an **actor** (human or technical user of the system).
- **Use cases and actors** define the functional respectively business scope of the project (= A-factor). This is recorded as Use Case Points.
- The **T-Factor** takes into account the non-functional requirements and technological constraints of the project. It is determined by a questionnaire.
- The **M-factor** takes into account the organizational complexity of the project and the environment. It is determined by a questionnaire.
- The total project effort is calculated with the help of the **productivity factor** (PF). This factor was determined in the recalculations and is predetermined. The effort includes both business and technical components and is proportional to the identified use case points.



The size / complexity of a use case is normalized by the number of steps, dialogues and scenarios

MAX (# steps # dialogues # scenarios)	complexity	points
0 – 3	simple	5
4 – 7	medium	10
>= 8	high	15

Definition of "steps" in the UCP method as a key figure

- **A step** in the sequence of a use case is defined as a self-contained business part of the use case, which is
  - clearly separated from the next and previous step, eg. by the change of the actor, or the processing "layer"
    (e.g. input dialog by the user-> processing the input on the server-> display the result)
  - generating a defined (intermediate) result *(i.e. generating prints)*
  - splitting up a new scenario
- We count all steps in a scenario. A distinct step is counted only once even it is included in several scenarios.
- Typical examples of steps:
  - Enter one or more values in a dialogue (without an intervening server round trip)
  - Call of application functions
  - Server transactions

The UCP method is based on functional size measurement and therefore not applicable for all project types

appropriate	not appropriate
• custom software development	• product customizing
• building new applications	• maintenance, i.e. slight adaptation of running systems
• implementation of new business processes	• version upgrades, control systems
• master data maintenance system	

conclusion

method is inappropriate
if scope of system adjustments is poorly described by use cases,
e.g. at technical upgrades, where the functional size (A-factor) varies only slightly

Disclaimer ...

- **Use Case Points are not terribly exact science – like all software metrics**
  - working with Use Case Points means accepting uncertainty and sometimes abstracting from details.

- **Use Case Points are not a silver bullet**
  - *"Garbage in - garbage out"*:
    If the estimation basis is so vague or incomplete that I can not identify use cases appropriately and almost enumerate completely, UCP also does not help.
  - *"If they do not fit the project, don't touch it."*
    Use Case Points can not be used for all projects effectively.

AGENDA

1. Basics and Definitions
2. Bottom-Up Estimation (Expert Estimation)
3. **Top-Down Estimation (Use Case Points)**
4. **Literature**

Literature

- Frohnhoff, S.: “Use Case Points 3.0 Implementation of an Use Case based Estimating Method for the Software Engineering of Business Information Systems“, 2009 http://digital.ub.uni-paderborn.de/hs/content/titleinfo/5490
- Balzert, H.: Lehrbuch der Software-Technik, Band 1, Software-Entwicklung. Spektrum Akademischer Verlag, 2. Auflage, 2000.
- Siedersleben, J.: “Softwaretechnik – Praxiswissen für Software- Ingenieure” 2. überarbeitete und aktualisierte Auflage, Hanser Verlag, 2003.
- Frohnhoff, S.; Jung, V.; Engels, G.: “Use Case Points in der industriellen Praxis” In “Applied Software Measurement - Proceedings of the International Workshop on Software Metrics and DASMA Software Metrik Kongress”, Abran, A. et al. Eds. Shaker Verlag, 2006, pp. 511-526
- Cockburn, A.: “Writing Effective Use Cases”, Addison-Wesley, 2001.
- Smith, J.: „The Estimation of Effort Based on Use Cases“, Rational Software, Cupertino, CA.TP-171, October 1999. http://whitepapers.zdnet.co.uk/0,39025945,60071904p-39000629q,00.htm

Any questions?

Mittwoch, 6.5.2015

- Gespräche am **Messestand**
- **Kontest:** IT-Abschluss in der Tasche — und jetzt?

  Was macht IT-Experten und -Berater so besonders?

  Und weshalb ist es interessant, in diesem Bereich tätig zu sein?

  Zeit: 10:45 – 12:15 Uhr | Raum: 2.07 aurum
- **Vortrag:** Ihr Einstieg in die IT-Welt der Finanzbranche (msgGillardon)

  Zeit: 13:00 – 13:30 Uhr | Raum: 3.08 neon

Vielen Dank für Ihre Aufmerksamkeit

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Senior Project Manager
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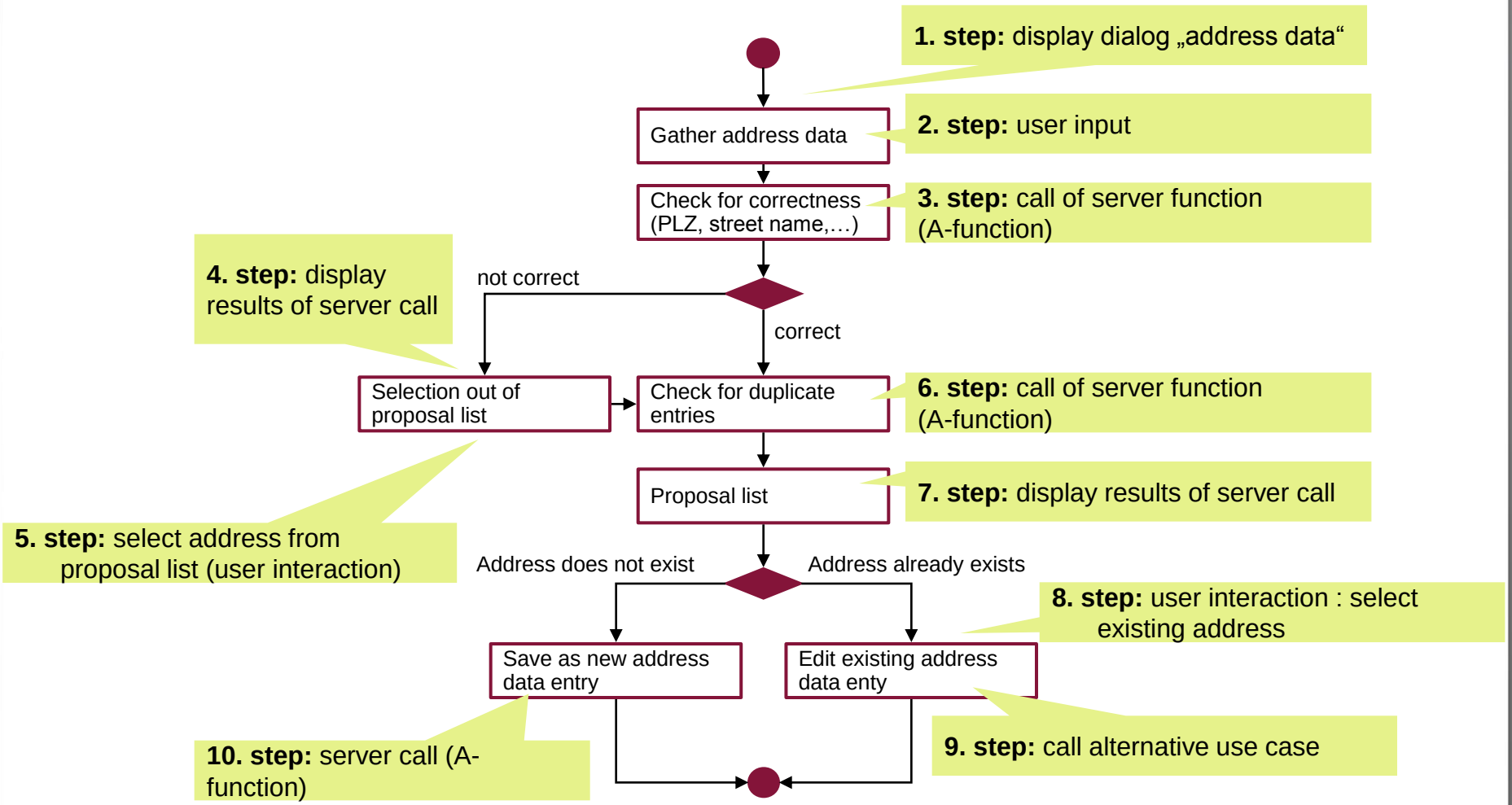
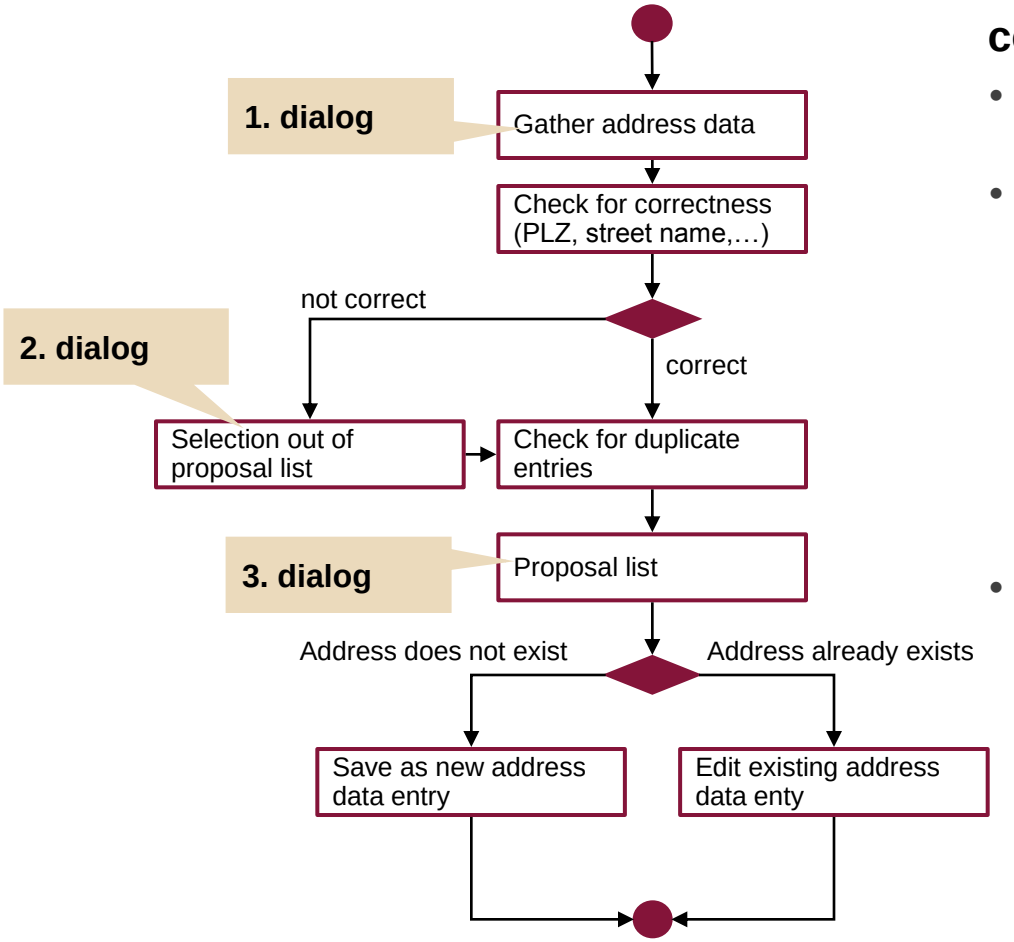
Appendix

- UCP – example use case with counting rules

Example use case: *register address* – count the steps –



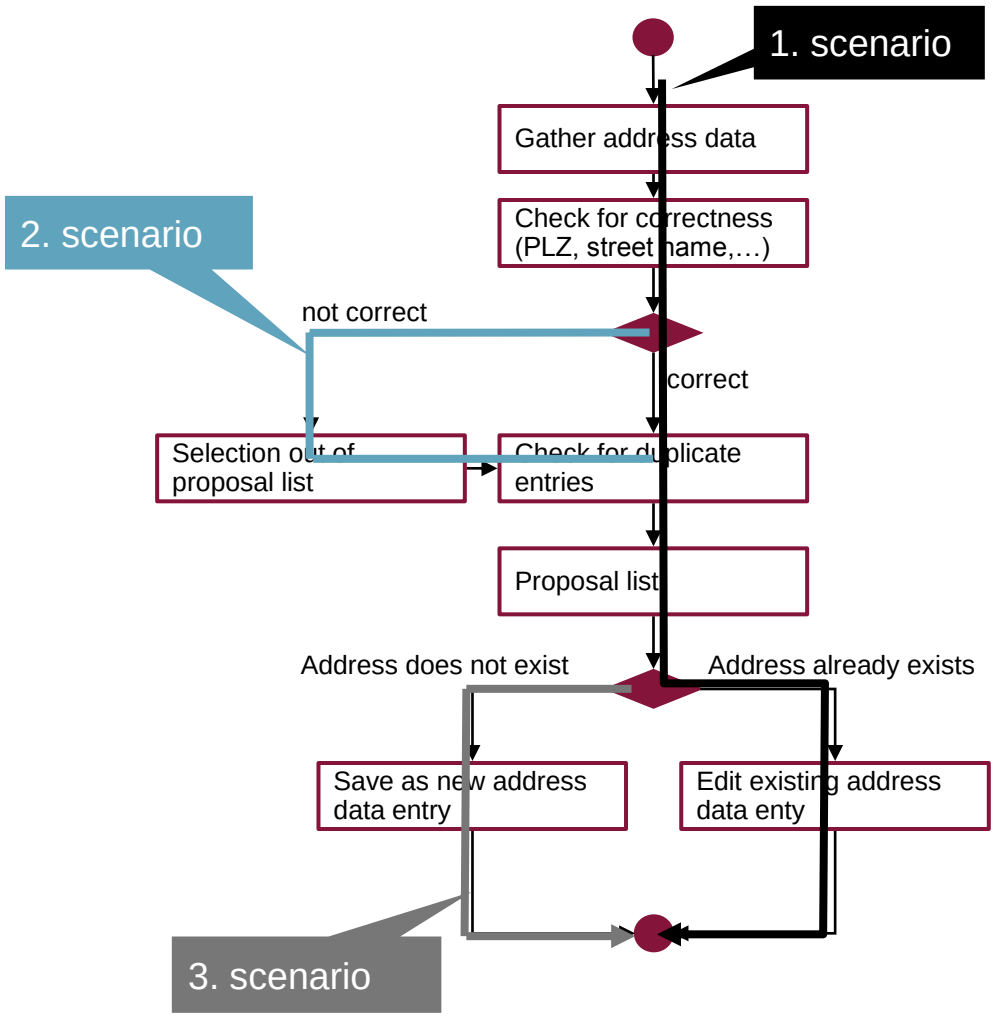
Example use case: *register address* – count the dialogs –



counting rules: number of dialogs

- The number of different dialogs of the use case is counted.
- Dialogs are counted as follows:
  - Every tab of a dialog (with significant technical differences) is counted as a separate dialog,
  - trivial pop-ups, confirmations and menus are not counted,
  - message pages are counted only if data can be entered.
- Print outputs are also counted as dialogs

Example use case: *register address* – count the scenarios –

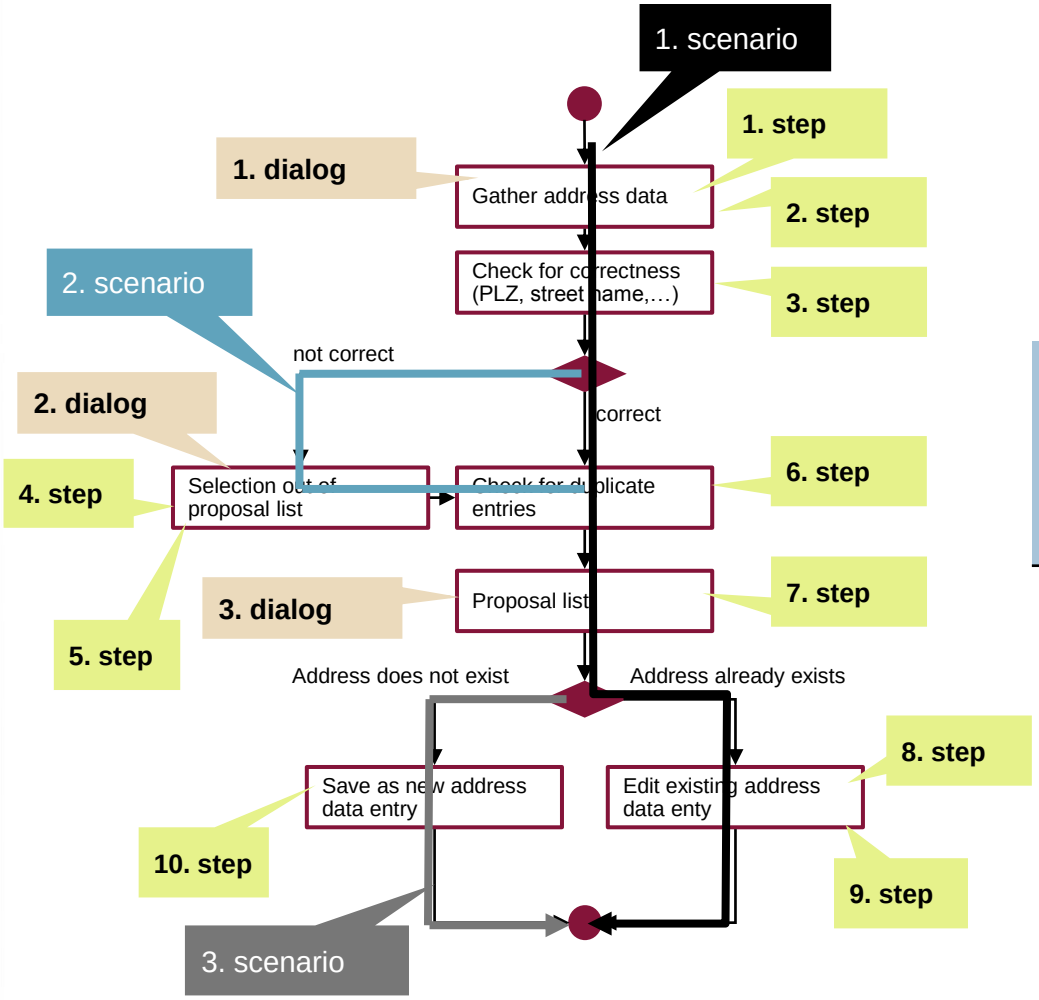


Counting rules: number of scenarios

- Count the number of different successful scenarios and non-trivial error scenarios in use case
- A success scenario is a possible business flow of the use case leading to success (achievement of the business goal), e.g.
  - the main scenario ("Main Flow") of the use case
  - business alternative scenario of the use case (trivial variations such as "display a message then abort" are not counted)
- Failure scenarios are those that do not lead to success (achievement of the business goal)
  - business fault scenarios are counted (if steps are performed for error handling)
  - do not count trivial error scenarios, e.g. “display a message then abort"

Example use case: *register address* – assigning complexity –

The size / complexity of a use case is normalized by the number of steps, dialogues and scenarios



Result for Use Case „register address“:

- 10 steps
- 3 dialogs
- 3 scenarios

MAX (# steps # dialogs # scenarios)	complexity	points
0 – 3	simple	5
4 – 7	medium	10
>= 8	high	15

high complexity = 15 Use Case Points