

Software Development Going Incremental, Iterative and Agile: Advantages and Challenges



An Industrial Case Study

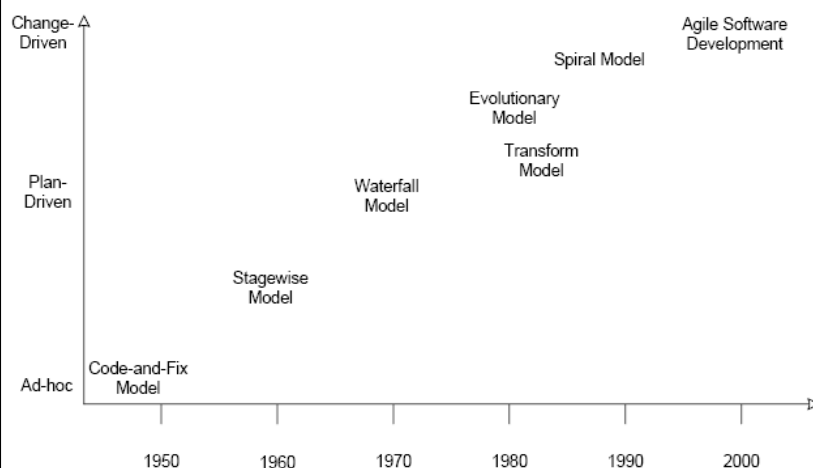
Prof. Claes Wohlin, Blekinge Institute of Technology, Sweden
 Professorial Visiting Fellow, UNSW

Kai Petersen (BTH / Ericsson AB)

www.bth.se
 BLEKINGE INSTITUTE OF TECHNOLOGY



The Evolution of Software Process Models



Salo, O. "Enabling Software Process Improvement in Agile Software Development Teams and Organisations" thesis, VTT, Espoo, 2006, Finland.

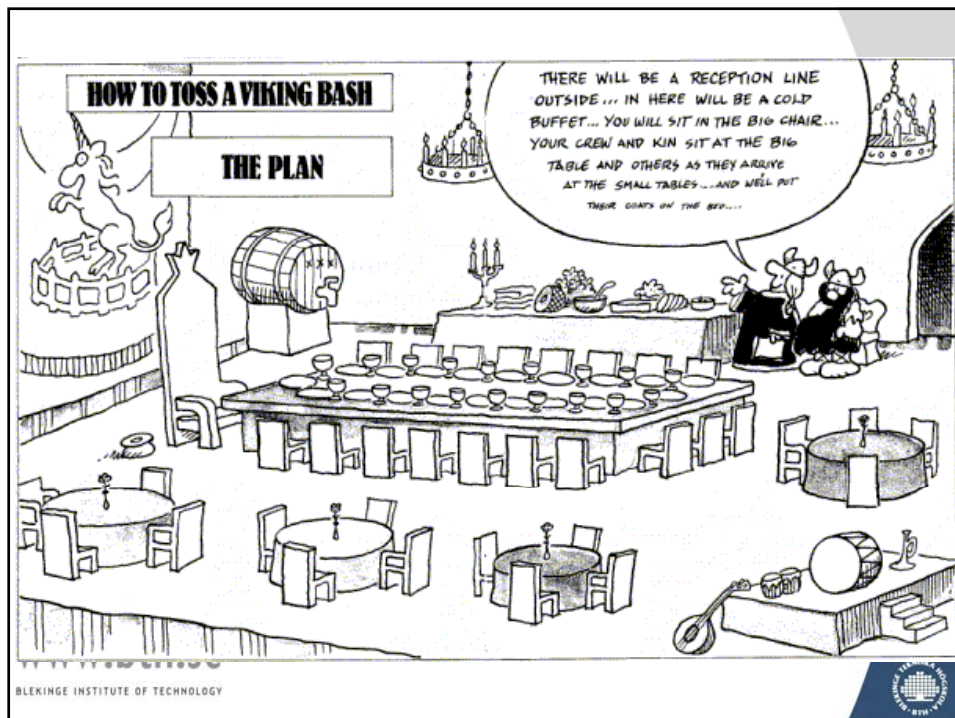
www.bth.se
 BLEKINGE INSTITUTE OF TECHNOLOGY

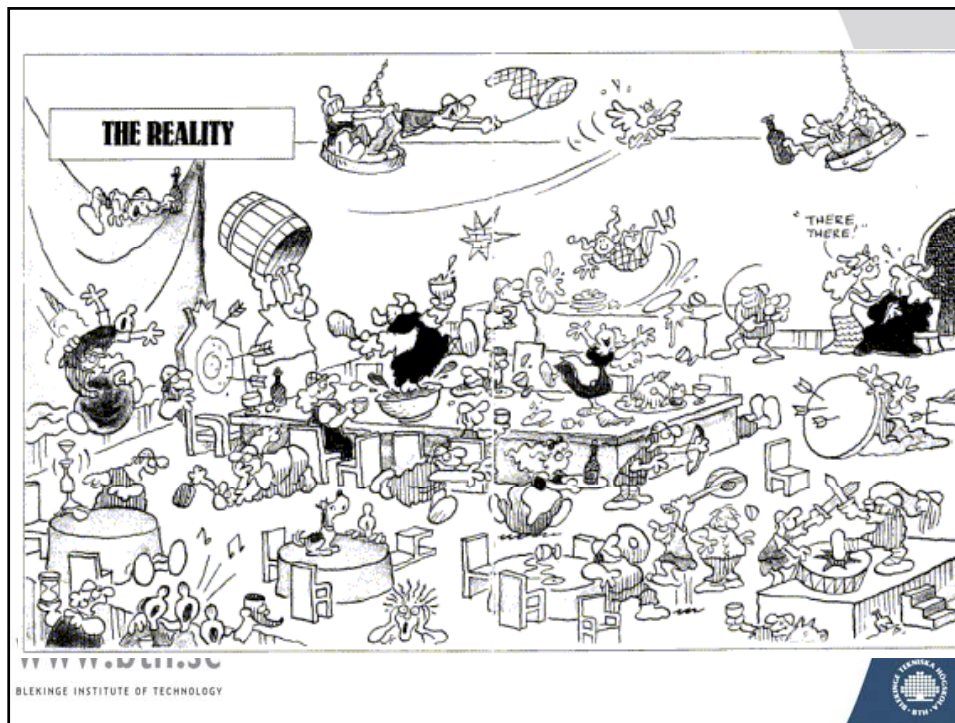


Plan versus Change Driven Development

	Plan-driven models	Change-driven models
Communication	Processes and tools are more important than informal communication	Self-organizing teams that coordinate by informal communication
Management	Command-and-control style of management with clear separation of roles	The project manager is a coach or facilitator. The team organizes itself and makes the decisions concerning what to do
Documentation	All tasks to be performed and the desired outcomes of each phase is specified from the beginning	Processes, principles, work structures are recognized during the project rather than predetermined

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY





Motivation for Work

- **Flexibility** in reacting to changing requirements is a major success factor for software companies
- Plan-driven approaches are not sufficiently flexible
- Research gap:
 - Understanding of agile methods (issues / benefits)
 - Focus only on XP
 - Lack of rigor in research methods
 - Understanding of the impact of process change including agile
- Thus: We need (**industrial**) studies **comparing** incremental/iterative/agile with other models

Study Goals



- Gain an **in-depth understanding** of benefits and problems in different development approaches and **comparison** between them. For example, what are the actual problems with a waterfall approach?
- **Measure** the impact of change from waterfall to a mixture of incremental, iterative and agile

www.bth.se

BLEKINGE INSTITUTE OF TECHNOLOGY



Research context

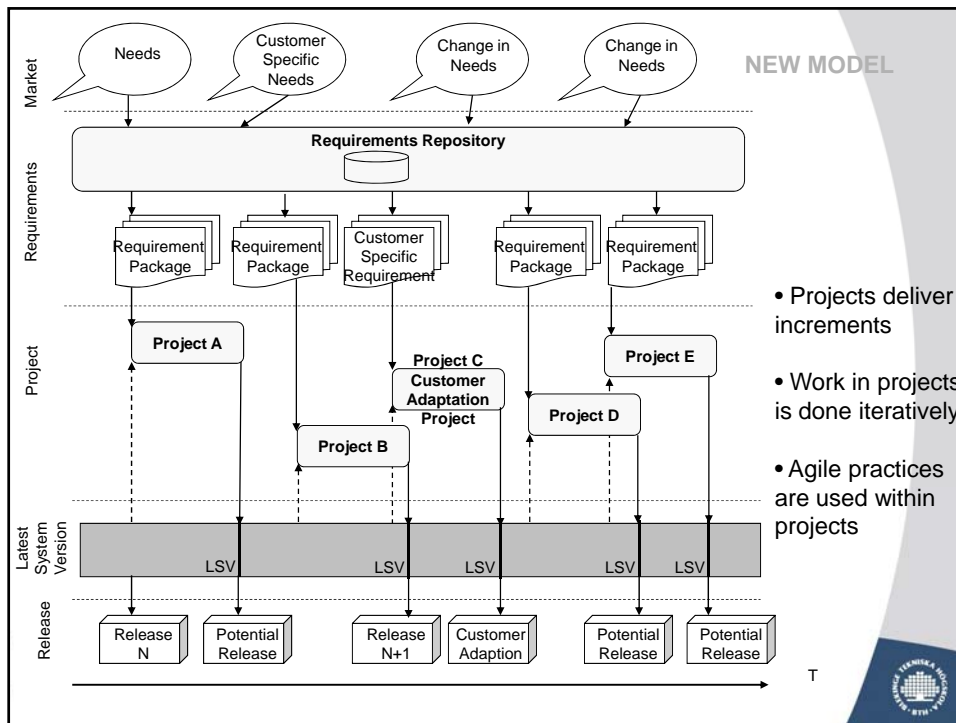
- **Company:**
 - Industrial case study at Ericsson AB, Karlskrona
 - Telecommunication domain, dynamic market, high degree of customization, global software engineering
 - Moving from a waterfall approach with projects taking 12-18 months to an approach that is a combination of incremental, iterative and agile



www.bth.se

BLEKINGE INSTITUTE OF TECHNOLOGY





Agile and Incremental Practices @Company (marked with red)



Principle	Incremental	XP	SCRUM	
Iterations and Increments	X	X	X	X
Internal and External Releases	X			X
Time Boxing	X	X	X	X
No Change of Started Projects	X		X	X
Incremental Deliveries	X			
On-site Customer		X	X	
Frequent Face-to-Face Interaction		X	X	X
Self-Organizing Teams		X	X	
Empirical Process		X	X	
Sustainable Discipline		X		
Adaptive Planning		X	X	
Requirements Prioritization		X	X	X
Fast Decision Making			X	
Frequent Integration		X	X	X
Simplicity of Design		X		
Refactoring		X		
Team Code Ownership		X		

Research context - system



- Units of Analysis:




	Language	Size (LOC)	#Persons
Overall Sys		> 5,000.000	-
Subsystem 1	C++	300,000	43
Subsystem 2	C++	850,000	53
Subsystem 3	Java	24,000	17
Apache	C++	220,000	90

Research questions

- What are the issues / benefits of the waterfall model and the new development model respectively, and how do they differ?
- How have performance measures changed after implementing the new model?

Research design: data collection

Several data collections methods were used:

- 33 interviews across the whole development lifecycle (different roles) covering different subsystems with more than 30 hours of transcribed interview data 
- Archival analysis of process documentation 
- Measurements collected by company
 - Requirements waste and change requests 
 - Quality data (fault-slip-through, maintenance)

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Research design: data analysis

A model for classification was developed:

- General issues (relevant for more than one sub-system and more than one role)
 - Number of responses used to classify issues into: critical (A), very important (B), important factors (C) and others (D)
- Local issues (only one component or one role)

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Results: Comparison of issues

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Class.	Mod.	PA	Description
A	WF	RE	Waste of requirements work
A	WF	VV	Reduction of test coverage
B	WF	VV	Amount of faults increases with late test
B	WF	VV	Faults found late hard / expensive to fix
B	IIA	VV	Low quality in system test increases testing time
C	WF	RE	Too much unused documentation produced in RE
C	WF	D	Design free capacity due to long RE duration
C	WF	D	Confusion who implements what requirements
C	WF	Maint.	High number of corrections released
C	WF	PM	Specialized competence / lack of confidence
C	IIA	VV	Reduction of test coverage
C	IIA	Rel.	Release project involved too late in process
C	IIA	PM	Management overhead for coordination



Class.	Mod.	PA	Description
A	WF	RE	Waste of requirements work
A	WF	VV	Reduction of test coverage
B	WF	VV	Amount of test cases
B	WF	VV	Fault density
B	IIA	VV	Low quality in system increases testing time
C	WF	RE	Too much unused doc. produced in RE
C	WF	D	Design errors
C	WF	D	Confusion and inconsistency in requirements
C	WF	Maint.	High number of corrections required
C	WF	PM	Specified number of iterations
C	IIA	VV	Reduction of test coverage
C	IIA	Rel.	Release project involved too late in process
C	IIA	PM	Management overhead for coordination

9 out of 13 general issues are related to the waterfall model

AND

The waterfall issues are more crucial (see issues A and B)

Class.	Mod.	PA	Description
A	WF	RE	Waste of requirements work
A	WF	VV	Reduction of test coverage
B	WF	VV	Amount of test cases
B	WF	VV	Fault density
B	IIA	VV	Low quality in system increases testing time
C	WF	RE	Too much unused doc. produced in RE
C	WF	D	Design errors
C	WF	D	Confusion and inconsistency in requirements
C	WF	Maint.	High number of corrections required
C	WF	PM	Specified number of iterations
C	IIA	VV	Reduction of test coverage
C	IIA	Rel.	Release project involved too late in process
C	IIA	PM	Management overhead for coordination

The major problems are related to requirements engineering and verification and validation

For agile, the verification problem is the highest ranked

Severity of requirements problem seems reduced

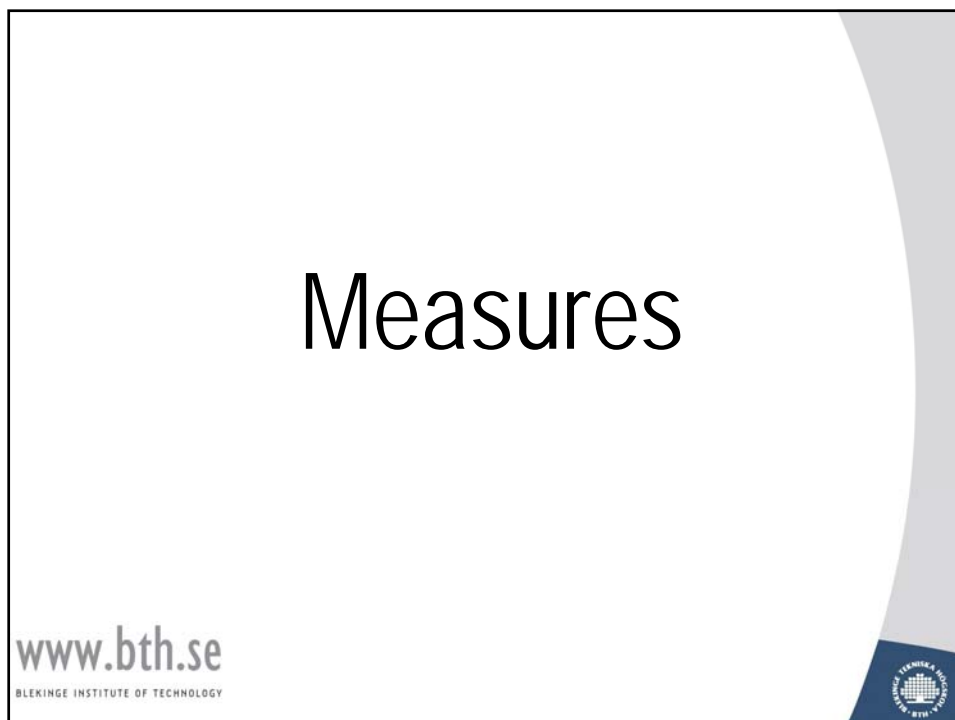

Class.	Mod.	PA	Description
A	WF	RE	Waste of requirements work
A	WF	VV	Reduction of test coverage
B	WF	VV	Amount of faults increases with late test
B	WF	VV	Faults found late hard / expensive to fix
B	IIA	VV	L
C	WF	RE	T
C	WF	D	D
C	WF	D	Confusingly implements what requirements vers.
C	WF	Maint.	High number of corrections released
C	WF	PM	Specialized competence / lack of confidence
C	IIA	VV	Reduction of test coverage
C	IIA	Rel.	Release project involved too late in process
C	IIA	PM	Management overhead for coordination

Reduction of test coverage:
less of a problem in agile
development

Results:
Improvements
through new model

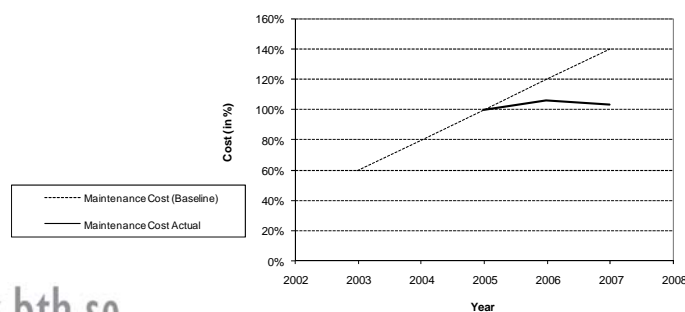
RE	More stable requirements reduce rework
RE	Everything started is implemented
RE	Estimations based on req. are more precise
VV	Early fault detection and feedback from test
VV	The duration of testing is reduced
PM	Moving people together reduces documentation (documentation replaced by direct communication)

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Quality measures

- Reduction of fault-slip-through in system test from 31 % to 19 % -> improvement in early testing
- Overall improvement in testing reflected in stabilized maintenance costs

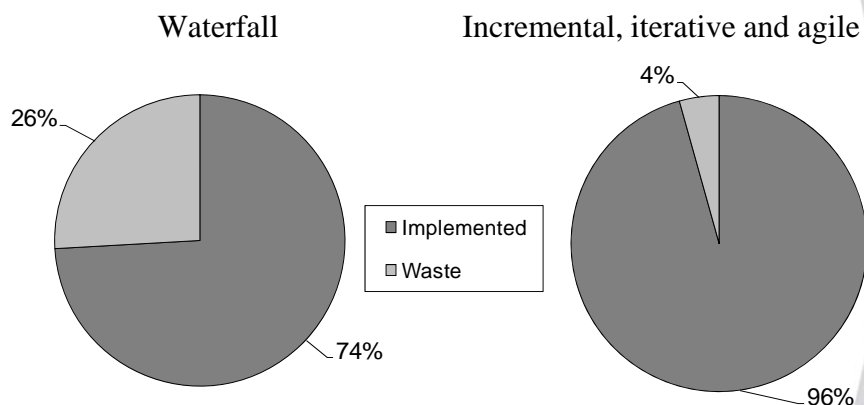


www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Requirements waste

Reduction of discarded requirements (less de-scoping)



www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



Conclusion

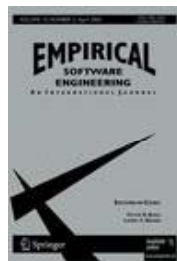
- Incremental, iterative and agile practices have reduced the severity of requirements engineering problems
- Test coverage and quality of the products are improved
- However, incremental, iterative and agile development comes with a set of new challenges!
 - Testing still requires improvement
 - Things get easier on project level, but become harder on product and management levels (e.g. coordination!)

www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY



More details

Petersen, K. and Wohlin, C., "The Effect of Moving from a Plan-driven to an Incremental Software Development Approach with Agile Practices", Empirical Software Engineering, Vol. 15, No. 6, pp. 654-693, 2010.



Questions?



www.bth.se
BLEKINGE INSTITUTE OF TECHNOLOGY

