INF5181: Process Improvement and Agile Methods in Systems Development

Lecture 04, 29.09.2011: Flow-based Agile Development (KANBAN)

Professor Dag Sjøberg

email: dagsj@ifi.uio.no

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Structure of lecture 04

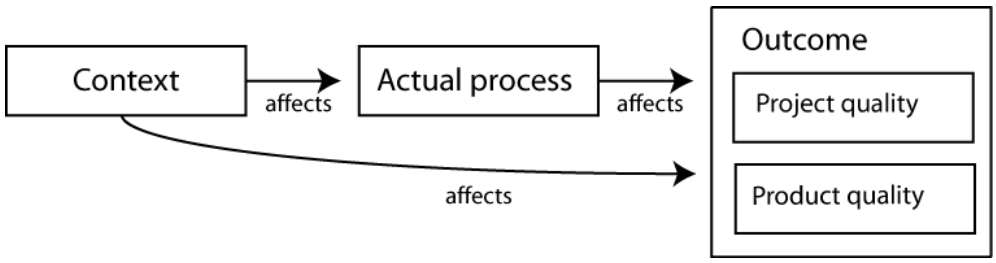
- Repetition of fundamental process concepts
- A study of concrete development processes
- Exercise: Characterizing development processes
- Flow-based agile development (Kanban)
- A study of Scrum versus Kanban in a software company

System Development Process

- A systems development process (= software process) are those activities that are carried out in order to develop a software system
- The activities vary, but will always includes the elements:
  - Specification of requirements, that is, what the system should do
  - Design of the system
  - Coding (programming)
  - Validation that the system satisfies the needs of the customer or user
  - Evolution of the system, that is, changes according to new or changed requirements

Process affects both project and system

- The development process, and the context in which it is performed, affect the quality of both the project itself and the resulting system being developed
- The process, that is the way one works, will also affect the work environment (work satisfaction, motivation, competence development, etc.), which in turn will affect project and product quality in general



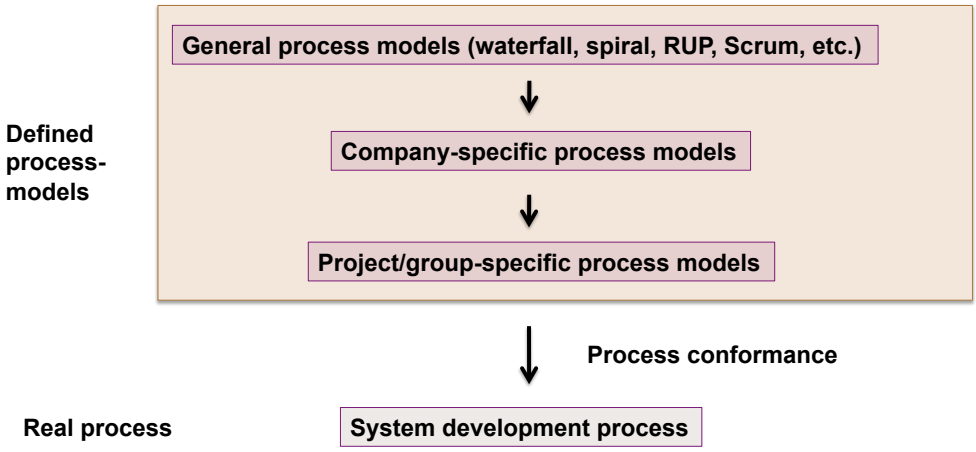
Aspects of process

- Which activities are included in the process?
- How much effort is spent on the various activities (in absolute and relative terms?
- What is the emphasis on the various activities during the development?
- The process descriptions may also include
  - Parts of the products/results of an activity
  - Roles of those involved in the process
  - Pre- and post-conditions that are true before and after a phase or a sub-product is produced

Process concepts

- System development process (=actual, real process)
  - Those activities that are carried out in a development project
- Process model
  - An abstract representation of a process. The model describe the process from a certain perspective
- A process model may be
  - Descriptive, that is, it describes an actual process the way *it is*
  - Prescriptive, that is, it describes a process the way *it should be* (the most common meaning)

Levels av process models



Software process models

- The waterfall model
  - Plan-driven model. Separate and distinct phases of specification and development.
- Incremental development
  - Specification, development and validation are interleaved. May be plan-driven or agile.
- Reuse-oriented software engineering
  - The system is assembled from existing components. May be plan-driven or agile.

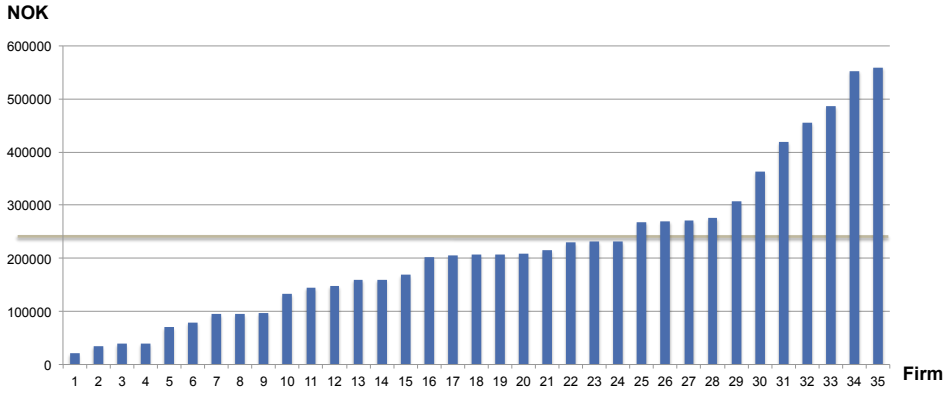
In practice, most large systems are developed using a process that incorporates elements from all of these models.

A study of concrete processes

- What kind of process is useful in which situations?
- Little exact knowledge in the area, very much hype and subjective opinions
- To study the effect of various aspects of context and process, we carried out a study in which four companies developed the same system independently

Variation in costs, time and quality for development of the same system

Bid from 35 Norwegian and multi-national IT-companies on a well-specified, small web-based information system (from 21 000 NOK to 560 000 NOK)*



*B.C.D. Anda, D.I.K. Sjøberg and A. Mockus. Variability and Reproducibility in Software Engineering: A Study of four Companies that Developed the same System, *IEEE Transactions on Software Engineering* 35(3):407-429, 2009

Variation in bids IT projects versus road projects

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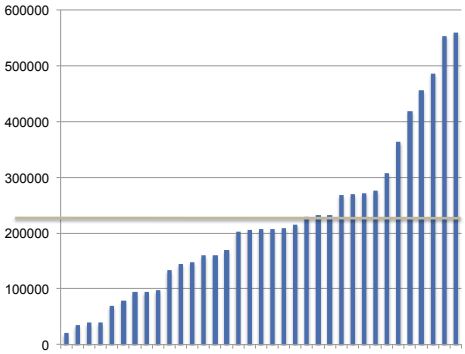

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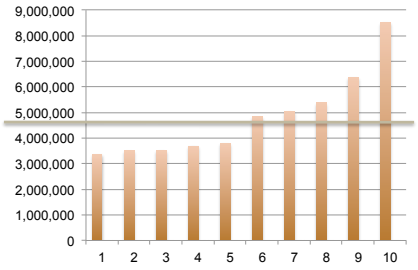
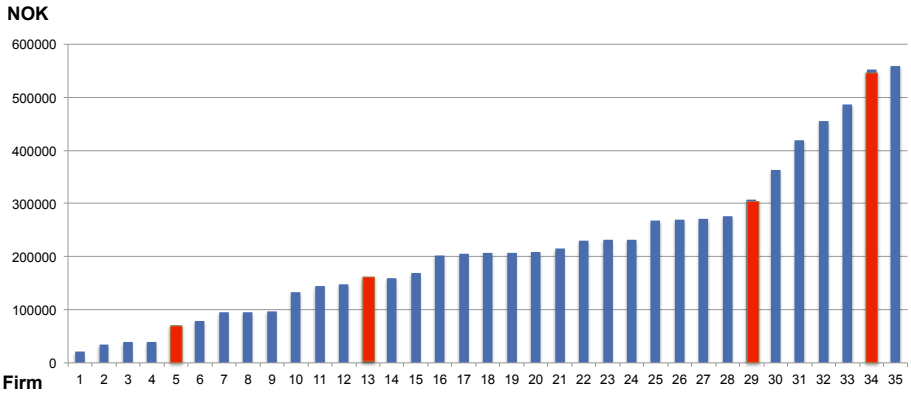


***H. Pedersen, "Tender Prices: Bridge, Tunnel, Electro and Road Building and Maintenance 1998-2006", Technology Report 2468, Norwegian Public Roads Administration, 2006**

Potential variation in time on development and quality of the system

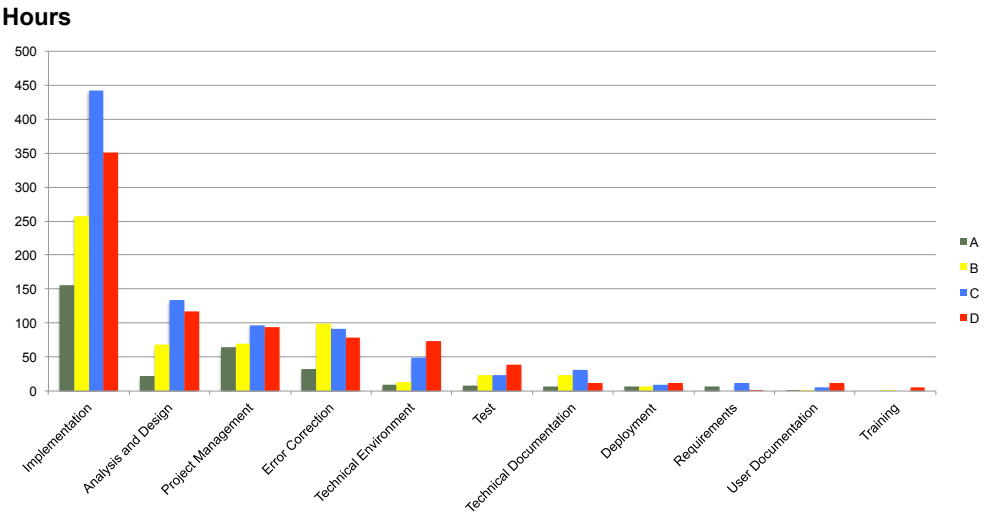
How would that great variation in costs result in differences in time & quality? We paid four companies to develop the same system independently of each other



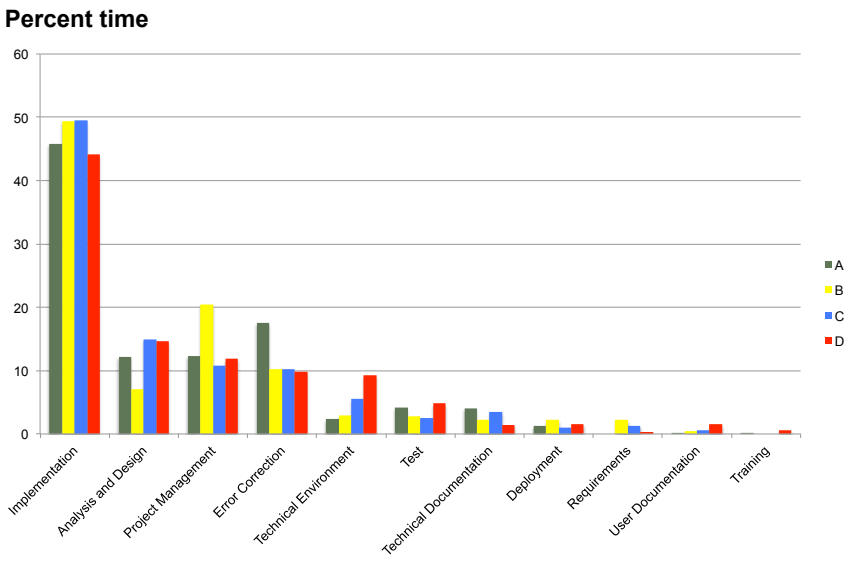
Activity	Sub-activity	Hours
Analysis and Design	Unspecified	100
Analysis and Design	Class diagrams (and other diagrams)	89
Analysis and Design	Functional design	56
Analysis and Design	Technical design	33
Analysis and Design	Logical architecture	18
Analysis and Design	Graphical design	15
Analysis and Design	Data model	9
Analysis and Design	Web site model	5
Analysis and Design	Navigation and page flow	4
Analysis and Design	Sequence diagrams	4
Analysis and Design	Log on integration	3
Analysis and Design	Class diagrams	2
Analysis and Design	Design meeting with user	2
Analysis and Design	Integration analysis and specification of formats	1
Analysis and Design	Architectural overview	0
Analysis and Design	Prototype development	0
Deployment	Unspecified	23
Deployment	Installer løsning	6
Deployment	Acceptance Test	5
Deployment	Deployment	2
Deployment	empty	0
Error Correction	Unspecified	204
Error Correction	Error Correction after Test	97
Implementation	Develop use cases/functionality	566
Implementation	Unspecified	375
Implementation	Script (JSP/PHP)	117
Implementation	Unit Test	107
Implementation	HTML/structure	15
Implementation	Database Development	14
Implementation	Establish database	9
Implementation	Establish web environment	3

Activity	Sub-activity	Hours
Project Management	Unspecified	163
Project Management	Project Management	59
Project Management	Communication/Internal Management	48
Project Management	Project initiation and planning	21
Project Management	Communication/External Management	14
Project Management	Project meetings	9
Project Management	Initial meeting	6
Project Management	Preparations	4
Requirements	Unspecified	16
Requirements	Use case diagrams	4
Research Contribution	Unspecified	111
Research Contribution	Logging of activities	31
Research Contribution	Interviews	14
Research Contribution	Copy documents and code	10
Research Contribution	Wrap up activities	1
Technical Documentation	Unspecified	73
Technical Environment	Unspecified	74
Technical Environment	Establish development environment	41
Technical Environment	Establish web environment	17
Technical Environment	Establishment	9
Technical Environment	Establish test environment	3
Technical Environment	Establish database	2
Test	Unspecified	47
Test	Accomplishment of test	19
Test	Functional test	17
Test	Documentation	6
Test	Planning test	4
Test	Testdata	1
Training	Unspecified	6
User Documentation	Unspecified	19

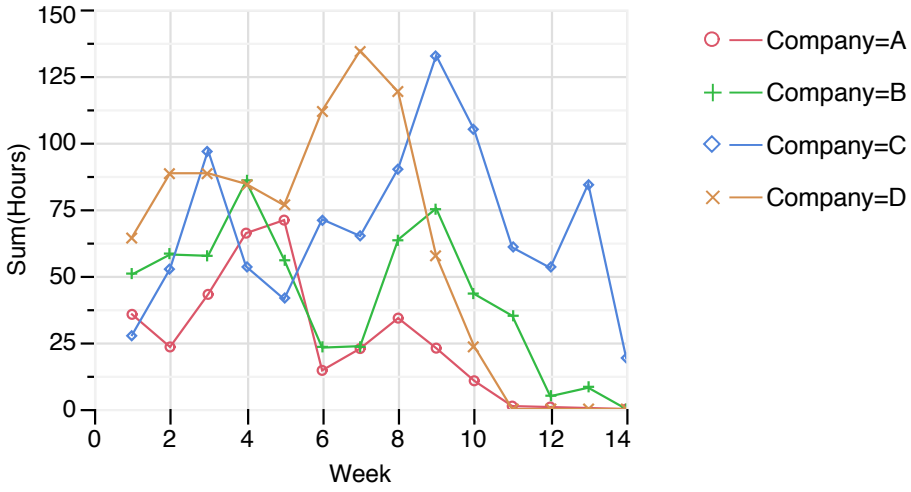
Process activities in the four companies



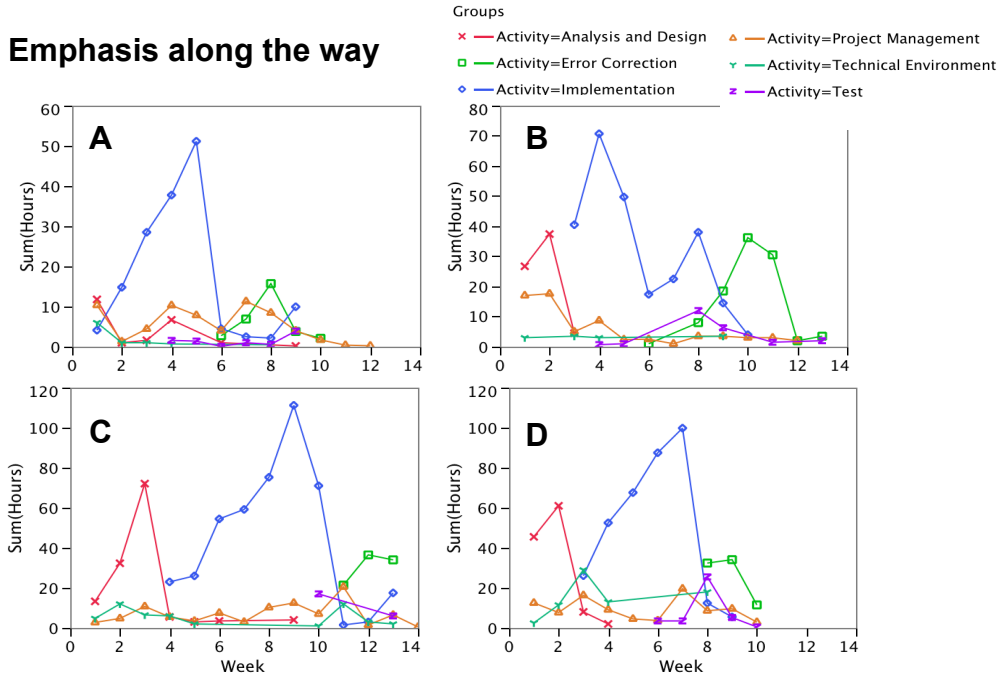
Relative emphasis of the activities



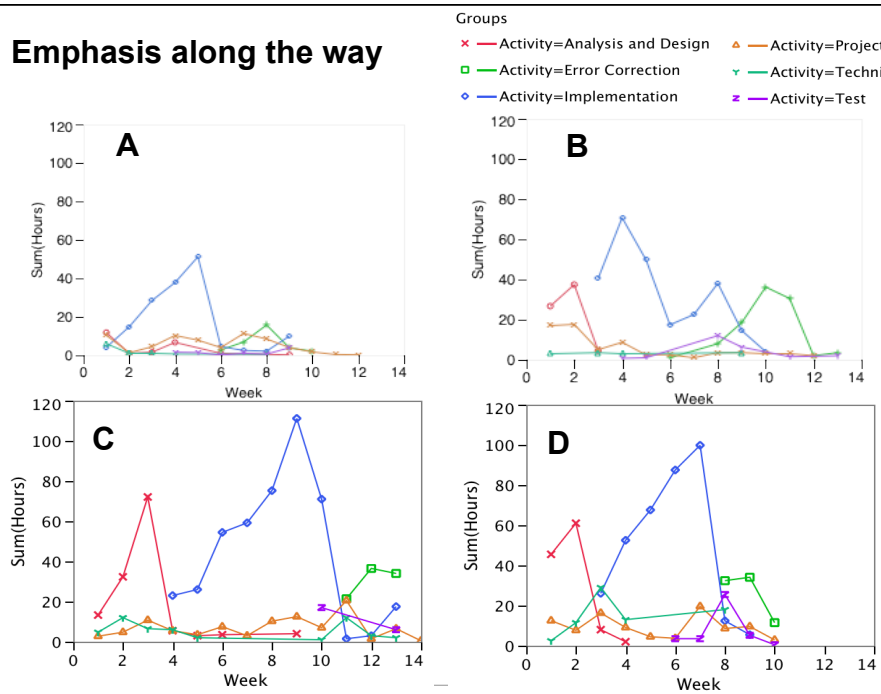
Time spent by the companies along the way



Emphasis along the way



Emphasis along the way



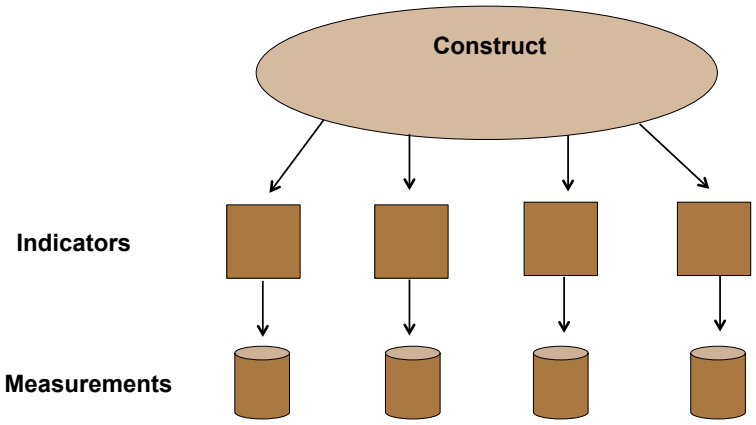
Exercise

- 3-4 persons in each group
- Characterize the processes and indicate possible consequences

Context variables 1: Constant in the study

Variabel	Value
Kunde	En forskningsinstitusjon
Kravspec.	Fast (database over vitenskapelige studier)
Applikasjonsdomene	Web dokumenthåndteringssystem
Funksjonell systemstørrelse	Lite (57 use case points)
Programmeringsspråk	Stort sett Java, noe Javascript, SQL, HTML, etc.
Verktøy	IDE: Netbeans el. Eclipse, Build & Deploy: Ant, CM: CVS
Team composition	1 prosjektleder, 2 utviklere
Developer skills	Mellomnivå

Measuring a construct



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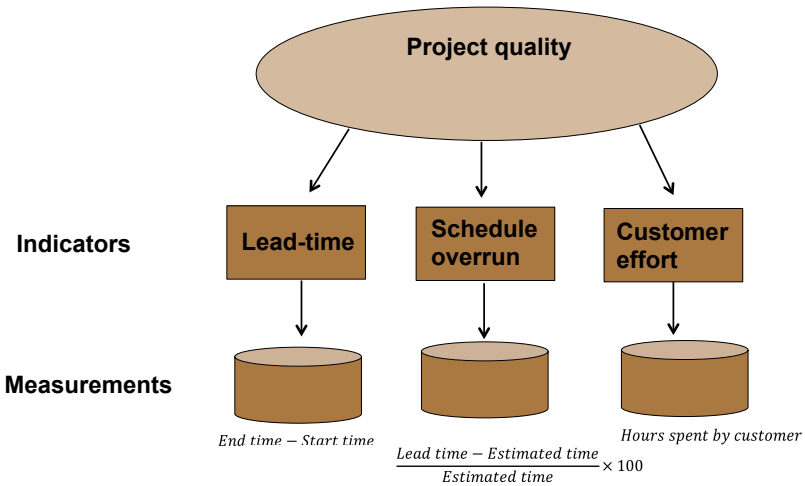
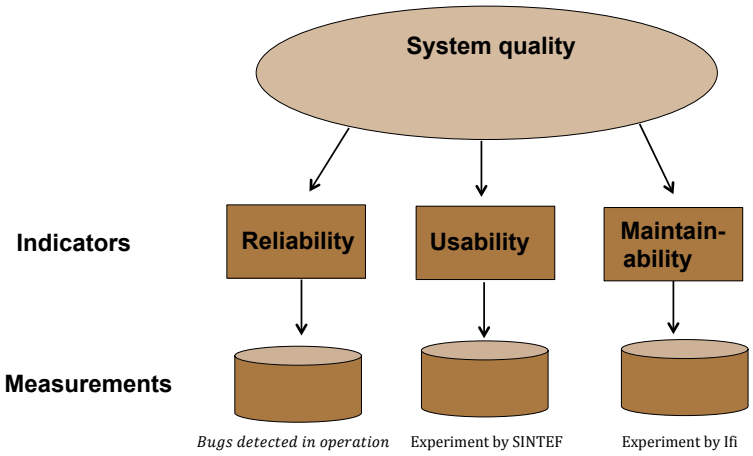
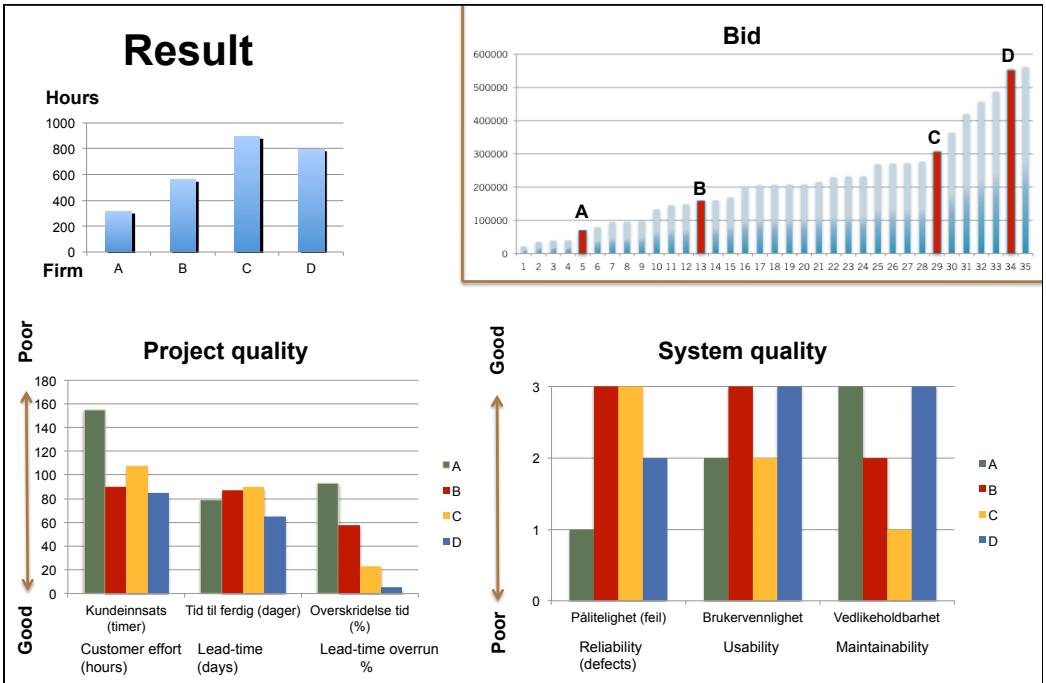
Measuring a Project Quality (this case)



Measuring a System Quality (this case)



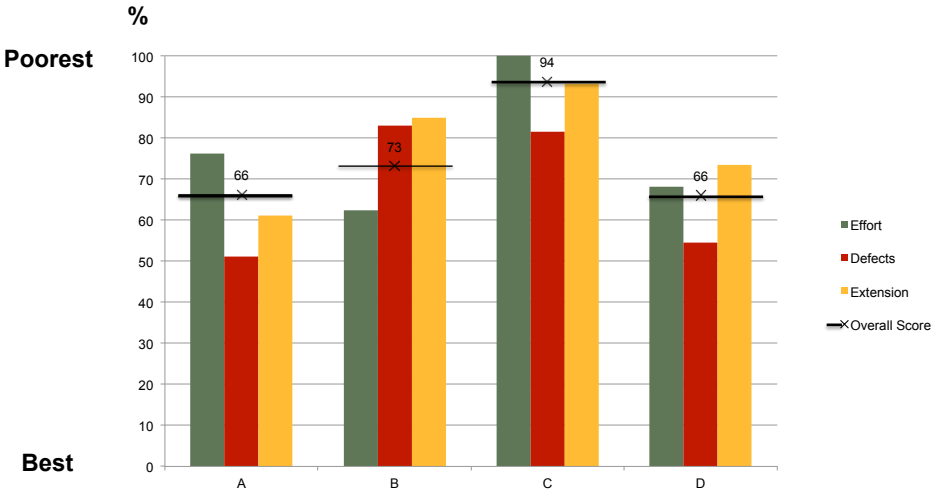
Which company do you think performed best / worst ?



How to evaluate maintainability?

- The systems used in parallel for two years. Stopped due to changes in platforms and web-environment. Changes had to be performed to make the systems operational again.
- Hired 6 experienced developers from the Czech Republic and Poland. The scored similarly in a Java experiment with 60 developers carried out earlier.
- The developers worked individually with 3 required change tasks on one system and repeated them on another system. They spent 3-4 weeks in total.

Result



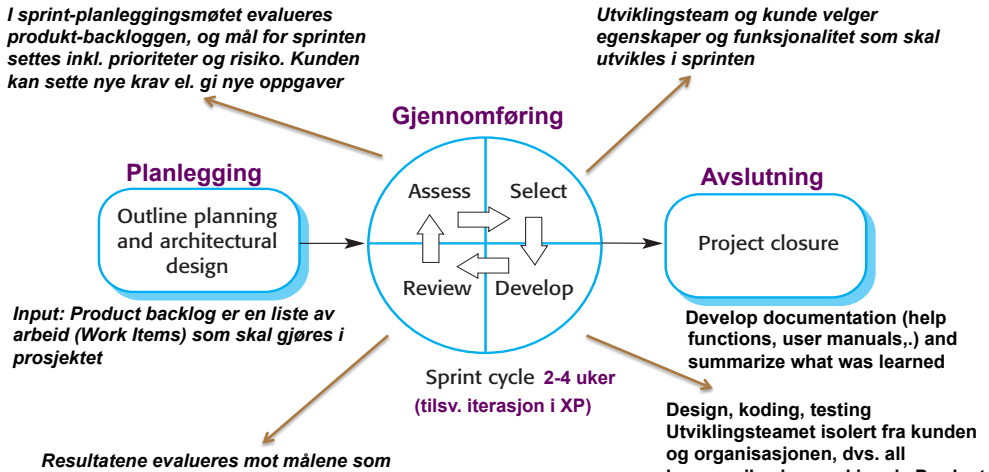
Part summary: Context and process do matter

- There are many different criteria of project and system quality
- A plethora of context and process parameters will influence project and system quality
- The choice of parameters will depend on which quality aspects that one would like to emphasize
- The systems described above are small, but there are many such systems! (and smaller additions to larger systems may have similar project size)
- The description above shows that even for small projects and systems there are many aspects of context and process that will affect the result

From general process context to agile

- Brief repetition of Scrum
- Flow-based development (Kanban)
- Scrum and Kanban process data collected from a company

Scrum



Figur delvis fra Ian Sommerville

Potential advantages of Scrum

- The system is divided into a set of understandable and manageable parts
- Unstable requirements don't hinder progress in the project
- All the team can observe what happens in the project, and good communications within the project is supported
- The customers receive increments on the agreed time and get continuous feedback on how parts of the system works
- Trust between customer and developers is established early in the project and creates a positive culture

Timeboxing versus "task-boxing"

- Scrum has sprints (iterations) of 2-4 weeks. But it's not always easy to divide the tasks or features of the systems to fit into this time interval
- What about instead define a set of tasks or features and deliver when finished?

Flow-based Development

Lean production

- "The Japanese school", primarily Toyota
  - If failure discovered, stop the assembly line and find the reason for the failure instead of collecting and fix the failures in bulks
  - Continuous learning and improvement (Kaizen)
  - "Just-in-time" (JIT) principle: don't produce anything before somebody demands it
  - Tempo in production is determined by pull from customer or next element in the production chain rather than push internally to produce as much as possible
  - Removal of temporary storage
  - Component-based production (same chassis, bumper, etc. on different car models). This way production can be geared towards the customer and components can be outsourced to third-party vendors
- Result: Toyota fewest failures and fastest production
- The most productive factories spent least resources on management and administration ("lean management")

Lean management

- Lean management is a hot issue in many sectors
  - Health management / hospitals
  - Public administration (incl. universities)
  - Private enterprises

In contrast: the Nordic model

- Autonomous teams
- Leaning, redundancy/job rotation
- User participation and work environment
- Quality of life
- Collaboration between management and trade unions (and government)
- Hydro, Volvo and many more

Produksjon versus design

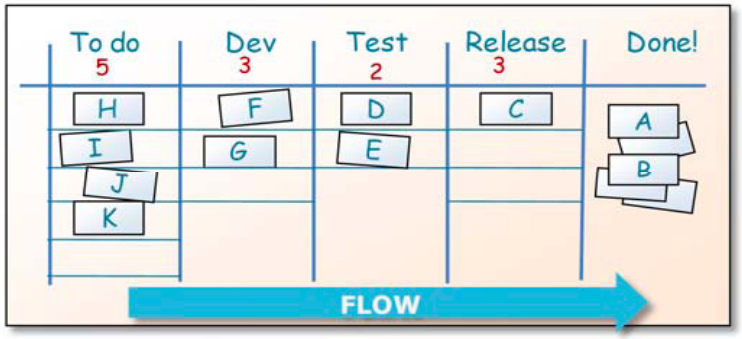
- Development of cars is primarily production while software development is primarily design
- To what extent can Toyotism and experiences from nordic production companies be applied in software development?

Kanban – a technique based on Lean Production

- Kanban focuses on:
  - Flow of work items (throughput/velocity), that is, the number of features/user stories implemented per unit of time
  - Lead-time (cycle time) = the time it takes to finish a user story/ work item

Kanban board

- A Work Item represents a unit of work to be carried out by the development team.
- Describe a Work item on a post-it sheet and put it on a board in one of the categories : "**To do**", "**In progress**" or more detailed states. "**Done**" shows the Wis that are finished.



From: Kanban and Scrum - making the most of both by Henrik Kniberg and Mattias Skarin on Dec 21, 2009

Kanban principles

- Limit Work In Progress (WIP). The more work items in parallel, the slower they flow through the work processes
  - WIP limit may be put on the total number of active work items or on the number of work items in a given state (to reduce bottlenecks)
- When a work item is finished, one can request to work on a new one (pull)
- To optimize flow, slack in the time schedule is OK. That is, a developer may have some waiting time now and then to optimize the overall flow
- Little focus on estimation
- See also http://www.infoq.com/articles/hiranabe-lean-agile-kanban

Advantages of Kanban

- Bottlenecks in the process become visible. Then easier to focus on finishing tasks that hampers the total flow instead of starting on new tasks that will pile up
- Can do agile development without focusing on timeboxing. Particularly for tasks regarding technical and user support, well-defined “sprints” may not be suitable

Need for empirical evidence

- Little empirical evidence on how various implementations of agile methods affect lead-time, quality and productivity in different branches and organizations

> “The choice of software technology (strategies, processes, methods, techniques, tools or languages) has been driven too much by hype, fashion, and self-proclaimed gurus with vested interests. Fortunately, there is now somewhat of an agreement that empirical evidence collected in a systematic way should be part of the basis for important decisions — having data to back up claims should be part of any scientific or engineering discipline. I also believe that this is appealing to most practitioners.”
>
> **[Empirical software research: an interview with Dag Sjøberg, University of Oslo, Norway. *ACM Ubiquity.* (June 2011)]**

Collaboration UiO and Software Innovation

"Universitetet i Oslo skal sammen med programvareselskapet Software Innovation forske på utviklingsmetodikkene Scrum og Kanban. Målet med samarbeidet er å opparbeide viktige empiriske data som sier noe om hvordan smidige prosesser påvirker kvalitet, produktivitet og lead-time – et område hvor det i dag eksisterer lite vitenskapelig dokumentasjon.

Software Innovation investerer hvert år store beløp i produktutvikling og har i dag mer enn 70 utviklere fordelt på R&D-avdelinger på IT Fornebu og i Bangalore."

Pressemelding 28.4.2011

Information about 10 000 development and bug-fix tasks were collected over a period of four years

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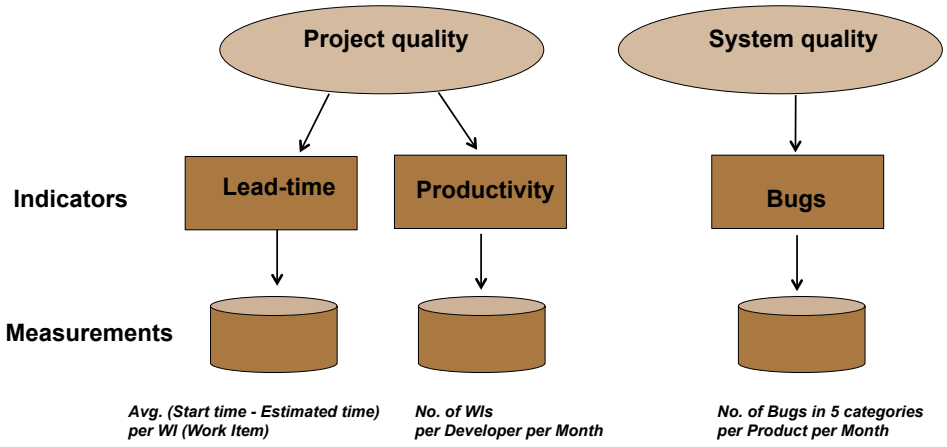
Measuring Process Quality



Lead-time

- **Normal definition:**
  - the time from a customer issues a request for a new or changed feature until it is implemented and deployed in the customer's environment
- **In the context of SI**, which is an in-house development company:
  - The time from the team receives the request (state "Next") until it's ready for release (state "Ready for release)

Questions

- Kanban claim: A fixed WIP (Work In Progress) will improve the process quality. Will it help to reduce the number of active WIs in total or by state?
- What's the mutual relationship between lead-time, productivity and quality?
- How does Kanban vs. Scrum perform with respect to lead-time, productivity and quality?

What kind of data do we collect?

Process	Product	WI_ID	Type	State From	State To	Direction	Date From	Date To
Scrum	ProArch	19363	Bug	In Progress	Done	1	16.04.201001:02:00	16.04.201009:10:25
Scrum	ProArch	19363	Bug	Not Done	In Progress	1	15.04.201015:01:29	15.04.201015:01:37
Kanban	ProArch	30921	PBI	Analysis-In Progress	Analysis-Done	1	26.11.2010 03:00:48	26.11.2010 06:00:26
Kanban	Common	33442	PBI	Development-Done	Released-	1	02.02.2011 03:13:07	02.02.2011 08:50:51
Kanban	Common	33442	PBI	Analysis-Done	Development-In Progress	1	17.01.2011 06:29:16	17.01.2011 06:29:31
Kanban	Common	33442	PBI	Next-	Analysis-In Progress	1	08.12.2010 14:27:41	08.12.2010 14:53:48
Kanban	Common	33732	PBI	Development-Done	Released-	1	13.12.2010 13:39:28	13.12.2010 13:40:10
Kanban	Common	33732	PBI	Next-	Analysis-In Progress	1	10.12.2010 10:18:11	10.12.2010 10:43:54
Kanban	Common	42868	Bug	Development-Done	Released-	1	03.02.2011 07:47:07	03.02.2011 07:47:41
Kanban	Common	42868	Bug	Analysis-Done	Development-In Progress	1	02.02.2011 13:55:29	02.02.2011 13:55:46
Kanban	Common	49723	PBI	Development-Done	Released-	1	10.03.2011 06:16:18	10.03.2011 06:16:31
Kanban	Common	49723	PBI	Released-	Development-	-1	10.03.2011 06:11:17	10.03.2011 06:14:32
Kanban	Common	49723	PBI	Next-	Released-	1	10.03.2011 06:08:01	10.03.2011 06:11:17
Scrum	ProArch	19363	Bug	In Progress	Done	1	16.04.201001:02:00	16.04.201009:10:25
Scrum	ProArch	19363	Bug	Not Done	In Progress	1	15.04.201015:01:29	15.04.201015:01:37

WI_ID	Title	Business Value	Testing Impact	Customer	Lead Time	Lines Added	Lines Modified	Lines Deleted	Churn Team
19363	Fix Unit tests		3 - High	XX					0
19363	Fix Unit tests		3 - High	xx	1	2	31	27	60
30921	Allow access to documents			xx					0
33442	TFS Backup Plan	810		Internal					0
33442	TFS Backup Plan	810		Internal					0
33442	TFS Backup Plan	810		Internal	56	0	0	0	0
33732	Need a new Test server for 360 Arabic			Internal					0
33732	Need a new Test server for 360 Arabic			Internal	4	0	0	0	0
42868	Need few 150 machines to be UP		3 - High	Internal					0
42868	Need few 150 machines to be UP		3 - High	Internal					0
49723	Separate machines for Msk			Internal					0
49723	Separate machines for Msk			Internal					0
49723	Separate machines for Msk			Internal	1	0	0	0	0
19363	Fix Unit tests		3 - High						0
19363	Fix Unit tests		3 - High		1	2	31	27	60

Preliminary results
(data collection and analysis is ongoing)

Relative importance of quality attributes

- What is most important of lead-time, productivity and quality?
- It depends on …

Summary of findings

- It seems that other process factors affect lead-time, productivity and bugs more than the use of the process models Scrum or Kanban
- However, so far the Kanban period has been short