OHT 7.1

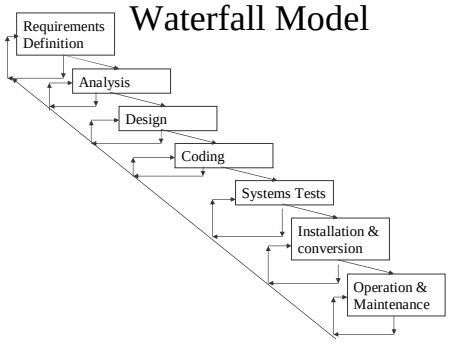
Presentation 7

Integrating quality activities in the project life cycle

- Software development methodologies:
  - The software development life cycle (SDLC) model
  - The prototyping model
  - The spiral model
  - The object-oriented model
- Factors affecting intensity of SQA activities
- Verification, validation and qualification
- Development and quality plans for small and for internal projects
- A model for SQA defect removal effectiveness and cost

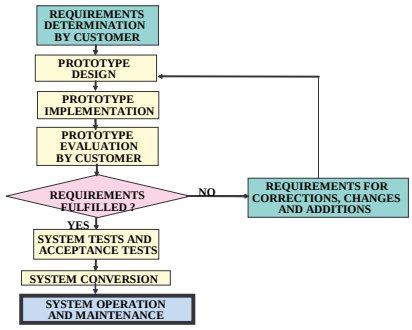
OHT 7.2

Waterfall Model



OHT 7.3

The prototyping model



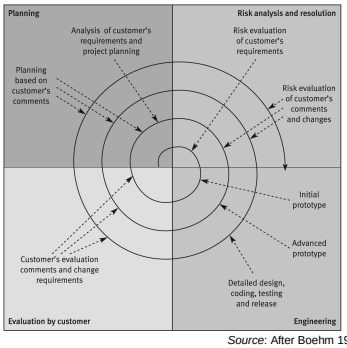
OHT 7.4

Prototyping V SDLC

- Advantages of Prototyping
  - Shorter development process
  - Savings of development resources
  - Better fit to customer requirements
  - Reduced risk of failure
  - Easier & faster user comprehension
- Disadvantages of Prototyping
  - Diminished flexibility & adaptability to changes
  - Reduced preparation for instances of failure
  - More difficult to manage

OHT 7.5

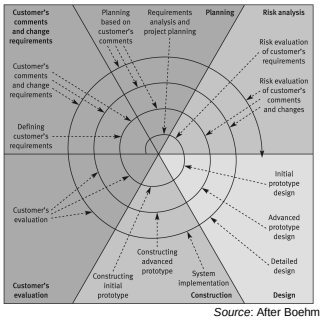
The Spiral Model



Source: After Boehm 1988 (© 1988 IEEE)

OHT 7.6

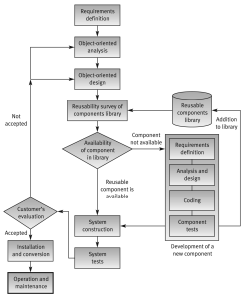
The Advanced Spiral model The Win-Win Model



Source: After Boehm 1998 (© 1988 IEEE)

OHT 7.7

Object Oriented Development Model



OHT 7.8

Factors affecting the required intensity of SQA activities

Project factors:
- **Project's magnitude**
- **Project's technical complexity and difficulty**
- **Extent of reusable software components**
- **Severity of failure outcomes if the project fails**

Team factors:
- **The professional qualification of the team members**
- **Team acquaintance with the project and its experience in the area**
- **Availability of staff members that can professionally support the team**
- **Familiarity with the team members, in other words, the percentage of new staff members in the team**

OHT 7.9

Verification, validation and qualification

Verification – The process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase

Validation - The process of evaluating a system or component during or at the end of the development process to determine whether it satisfies specified requirements

Qualification - The process used to determine whether a system or component is suitable for operational use

IEEE Std 610.12-1990 (IEEE 1990)

OHT 7.10

Model for SQA defect removal effectiveness and cost

The model's quantitative results:

a. **The SQA plan's total effectiveness in removing project defects**
b. **The total costs of removal of project defects**

OHT 7.11

Data

- Defect origin distribution
  - consistent
- Defect removal effectiveness
  - Each quality assurance activity filters a certain % of defects
- Cost of defect removal
  - Varies by development phase

OHT 7.12

The model

- Assumed linear & sequential (waterfall)
- New defects introduced at each phase
- Review & test SQA activities are filters
- Filtering efficiency is consistent
- Incoming defects are sum of earlier non-removed defects
- Average cost of defect removal is same for all phases
- Cost for each QA activity is (# defects removed) * (relative cost of removal)
- Remaining defects will be detected by customer

OHT 7.13

Defects originating and defect removal costs

Software development phase	Average % of defects originating in phase	Average relative defect removal cost
Requirement specification	15%	1
Design	35%	2.5
Unit coding	30%	6.5
Integration coding	10%	16
Documentation	10%	40
System testing	-----	40
Operation	-----	110

OHT 7.14

Defects removal effectiveness for quality assurance plans

Quality assurance activity	Defects removal effectiveness for standard SQA plan	Defects removal effectiveness for comprehensive SQA plan
Specification requirement review	50%	60%
Design inspection	-----	70%
Design review	50%	60%
Code inspection	-----	70%
Unit test	50%	40%
Integration tests	50%	60%
Documentation review	50%	60%
System test	50%	60%
Opertion phase detection	100%	100%

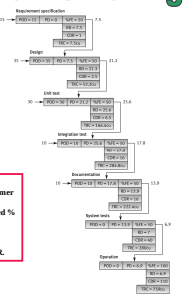
OHT 7.15

Defects removal effectiveness for quality assurance plans

Defect removal phase	Defect removal effectiveness	Average relative defect removal cost {cost unit}				
		Defect origination phase				
		Req	Des	Uni	Int	Doc
Requirement specification (Req)	**50%**	**1**	---	---	---	---
Design (Des)	**50%**	**2.5**	**1**	---	---	---
Unit coding (Uni)	**50%**	**6.5**	**2.6**	**1**	---	---
Integration (Int) System documentation (Doc)	**50%** **50%**	**16** **16**	**6.4** **6.4**	**2.5** **2.5**	**1**	**1**
System testing / Acceptance testing (Sys)	**50%**	**40**	**16**	**6.2**	**2.5**	**2.5**
Opertion by customer (after release)	**100%**	**110**	**44**	**17**	**6.9**	**6.9**

OHT 7.16

The standard quality assurance plan
The process of removing 100 defects



- **POD = Phase Originated Defects**
- **PD = Passed Defects (from former phase or former quality assurance activity)**
- **%FE = % of Filtering Effectiveness (also termed % screening effectiveness)**
- **RD = Removed Defects**
- **CDR = Cost of Defect Removal**
- **TRC = Total Removal Cost. TRC = RD x CDR.**

OHT 7.17

Slide 7.12a – relates to updated section 7.4

Defect correction effectiveness and cost - standard plan model of the process of correction 100 defects

Req. specification (POD=15)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID					15	15		
PD					7.5	7.5	%FE=50	7.5
RD					7.5	7.5		
RDRC					1	TRC >	7.5 cu	

Design (POD=35)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID				35	7.5	42.5		
PD				17.5	3.8	21.3	%FE=50	21.3
RD				17.5	3.7	21.2		
RDRC				1	2.5	TRC >	26.8 cu	

Unit tests (POD=30)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID				30	17.5	3.8	51.3	
PD				15	8.8	1.9	25.7	%FE=50
RD				15	8.7	1.9	25.6	25.7
RDRC				1	2.6	6.5	TRC >	50 cu

Integration tests (POD=10)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID		10	15	8.8	1.9	35.7		
PD		5	7.5	4.4	1.0	17.9	%FE=50	
RD		5	7.5	4.4	0.9	17.8		17.9
RDRC		1	2.5	6.4	1.6	TRC >	66.3 cu	

Documentation review (POD=10)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID	10	5	7.5	4.4	1.0	27.9		
PD	5	2.5	3.8	2.2	0.5	14.0	%FE=50	14.0
RD	5	2.5	3.7	2.2	0.5	13.9		
RDRC	1	1	2.5	6.4	16	TRC >	38.9 cu	

System tests (POD=0)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID	5	2.5	3.8	2.2	0.5	14.0		
PD	2.5	1.2	1.9	1.1	0.3	7.0	%FE=50	7.0
RD	2.5	1.3	1.9	1.1	0.2	7.0		
RDRC	2.5	2.5	6.2	1.6	40	TRC >	50.9 cu	

Operation by customer (POD=0)

	Ddoc	Dint	Duni	Ddes	Dreq	Total		
ID	2.5	1.2	1.9	1.1	0.3	7.0		
PD	0	0	0	0	0	0	%FE=50	
RD	2.5	1.2	1.9	1.1	0.3	7.0		
RDRC	6.9	6.9	17	44	110	TRC >	139.2 cu	