Multimedia-Programmierung

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A simple but important notice

- Im Hauptstudium sind viele aktuelle Materialien nur in englischer Sprache verfügbar.
- Programmiersprachen basieren auf englischem Vokabular.
- Austausch von Materialien zwischen Lehre und Forschung scheitert oft an der deutschen Sprache.
- Konsequenz:
  - Die wichtigsten Lehrmaterialien zu dieser Vorlesung (v.a. Folien) sind in englischer Sprache gehalten!
  - Der Unterricht findet (noch) in deutscher Sprache statt.

Multimedia Programming

- Creative Designers of multimedia content
  (e.g. using Macromedia Flash):
  - "Many Flash users avoid to program in Flash. They are afraid of the jump
    into the 'unknown' area of programming."

    > Cover text of
    > B. Dawes: Flash ActionScript for Designers: Drag Slide Fade

- Traditional programmers with interest in multimedia (like the author of
  these slides):
  - Multimedia programming is a special case of general programming
    » Why are then new development environments and even programming
    languages developed (like Macromedia Flash)?

- Questions (to be covered in this lecture):
  - Is there a need for bridging between graphical design and programming?
  - Are systems like Flash just unnecessary marketing tricks?
  - What is the most efficient way of developing multimedia applications?

What we will cover – and what not

- This lecture does *not* cover:
  - Treatment of multimedia data on low system levels (operating system,
    networks)
  - Production of media products which are consumed in a linear, non-
    interactive way (like movies)
- The focus of the lecture is on:
  - Graphical representation and (2D-)animation
  - Interaction, including multi-user applications
  - Integration of computer graphics with other kinds of media
  - Development process in team work using an "agile" working style
- The application area is:
  - Programming of games
- The example development environment is:
  - Macromedia Flash MX 2004 Professional, ActionScript 2.0

Organisatorisches

Ausnahmsweise auf Deutsch:

- Die Lehrveranstaltung ist eine Mischung aus:
  - Vorlesung (12 Doppelstunden)
  - Übungen (3 Doppelstunden)
  - Projektarbeit in kleinen Gruppen (10 Doppelstunden)
  - ... plus eigene Freiarbeit
- Um genügend zusammenhängende Zeit für die Projektphase zu schaffen, findet die Vorlesung gelegentlich *zweimal* pro Woche statt:
  - Jede Woche Dienstag 12-14 Uhr (The 113)
  - An den folgenden Terminen auch Mittwoch 14-16 Uhr (The 113): 21.4 (morgen!) und 19.5.
- Im Zeitraum 21.5.–20.7. findet die Projektphase statt:
  - Einteilung in kleinere Projektgruppen (je 6 Teilnehmer)

Outline (Preliminary)

1. Development process for multimedia projects
    1.1 Classical models of the software development process
    1.2 Special aspects of multimedia development projects
    1.3 Example: The SMART process
    1.4 Agile development and Extreme Programming
2. Development of multimedia applications
    2.1 Multimedia authoring tools - Example Macromedia Flash
    2.2 Elementary concepts of ActionScript
    2.3 Interaction in ActionScript
    2.4 Media classes in ActionScript
    2.5 Data access und distributed applications in ActionScript
3. Introduction to computer game programming
    3.1 Logic-based games
    3.2 Simulation-based games
4. Concepts and fundamental questions
    4.1 Alternative approaches for multimedia programming
    4.2 Graphic design, interaction design and software design
    4.3 Development trends
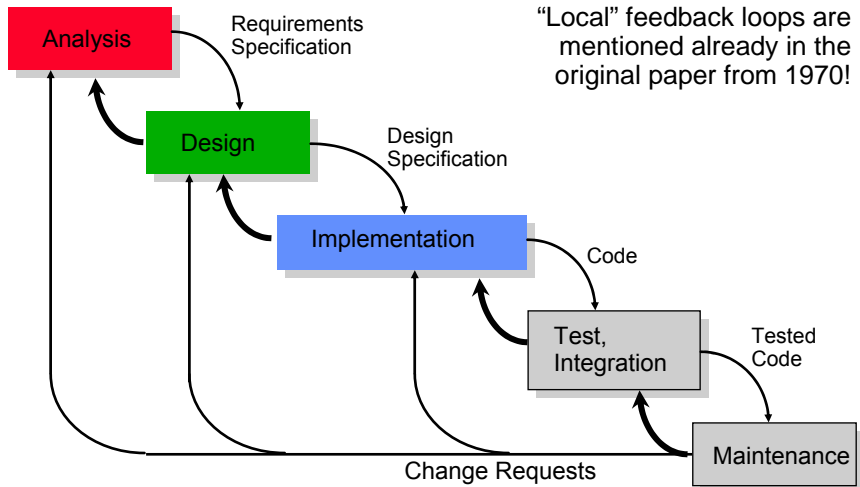
1 Development process for multimedia projects

Literature:
- Any textbook on Software Engineering.
- M. & T. Poppendieck: Lean Software Development, Addison-Wesley 2003
- K. Osswald: Konzeptmanagement. Interaktive Medien – interdisziplinäre Projekte, Springer 2003

The "Waterfall" Model - Textbook Version
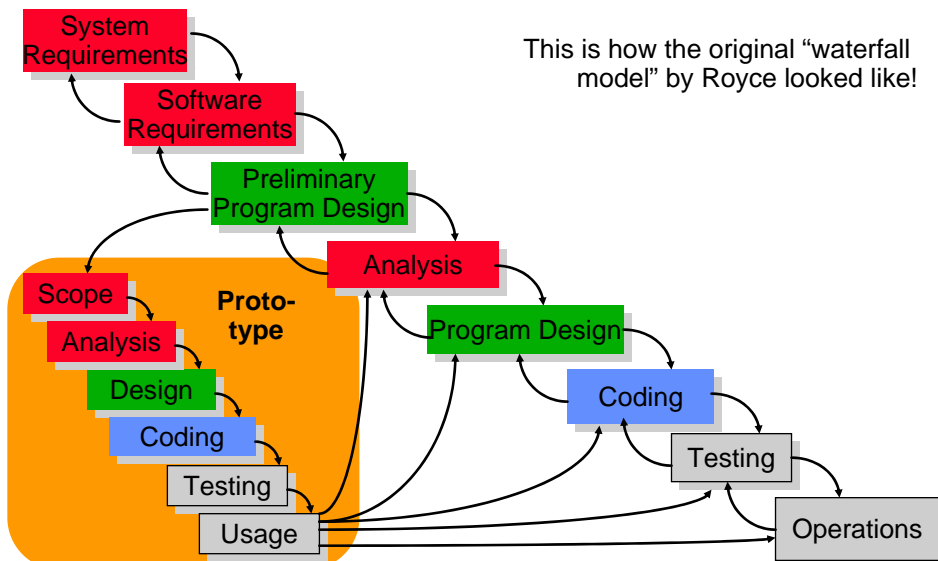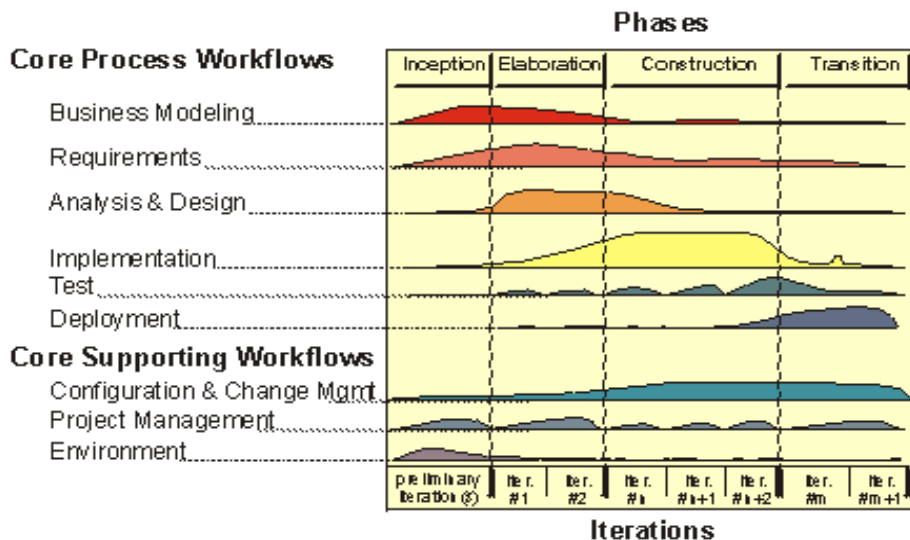
Analysis

Requirements Specification

Winston Royce, *Managing the Development of Large Software Systems,* 1970

Design

Design Specification

Implementation

Code

Test, Integration

Tested Code

Maintenance

Change Requests

"Waterfall" Feedback Loop #1: Quality Control

Analysis

Requirements
Specification

Design

Design
Specification

Implementation

Code

Test,
Integration

Tested
Code

Maintenance

Change Requests

"Local" feedback loops are
mentioned already in the
original paper from 1970!

"Waterfall" Feedback Loop #2: Prototyping

System
Requirements

Software
Requirements

Preliminary
Program Design

Analysis

Scope

Proto-
type

Analysis

Design

Coding

Testing

Usage

Program Design

Coding

Testing

Operations

This is how the original "waterfall
model" by Royce looked like!

A Modern Iterative/Incremental Process: Rational Unified Process

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Extreme Programming & Agile Development

- Preliminary: Central idea is *continuous feedback*
  - Feedback from customers at every development stage
  - Feedback from extensive testing at every development stage
  - How to make this work: See section 1.4 (next lecture)!
- Mainly suitable for volatile requirements and small projects
  - Of which kind is the *majority* of projects?
- Clear warning:
  - Not suitable for large-scale projects, nowadays...
- Historically:
  - Can be seen as "extreme" continuation of the idea of iterative development
    » E.g. Boehms "Spiral model"
  - Hype or long-term trend?
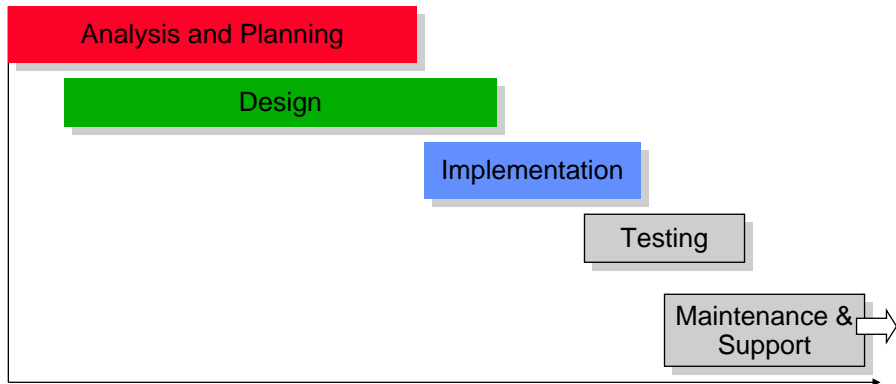
Planning for Change

- Fred Brooks, 1975: "Plan to throw one away; you will anyhow."
- David Lamb, 1988: Software engineering is "planning for change"
- Lessons learnt from traditional software engineering at this point:
  - *Iteration* is a key principle in all variants of the development process (from waterfall to modern process definitions)
  - *Incremental* development is suitable for small projects with volatile requirements
- What about *multimedia* projects?
  - Often limited in size (e.g. targeted at CD or DVD media)
  - Extreme speed in technological development impacts project directly
  - Requirements generally even more volatile than in traditional development projects
    - » "It shall be attractive and modern."
    - » "It shall be compatible with the latest technology developments in end systems."

Current Practice in Multimedia Industry?

- K. Osswald, 2001: Systematic interviews with companies from the German multimedia (interactive media) sector
  - Out of a basis of 3000 enterprises, 30 were selected and asked (the most successful enterprises according to rankings)
  - 22 enterprises took part in the study
- Results regarding the development process:
  - More than 80% of the companies apply the "waterfall model"
    - » In almost all cases, there is a large overlap between neighbouring project phases
  - Frequently used technique: Prototyping
  - More than 80% of the interviewed specialists complain that customers demand changes at a very late point in project time, regarding information architecture and concrete content
  - 18% of the companies are working on the introduction of an iterative incremental process model (similar to the Rational Unified Process)
    - » None had completed the transition by 2001

Waterfall Model as Used in Multimedia Industry

- Roy Strauss: Managing Multimedia Projects, Focal Press 1997
- Waterfall model adapted to multimedia projects
  - Highly consistent with the result of the interviews with German companies

Analysis and Planning

Design

Implementation

Testing

Maintenance &
Support

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1 Development process for multimedia projects

1.1   Classical models of the software development process

1.2   Special aspects of multimedia development projects

1.3   Example: The SMART process

1.4   Agile development and Extreme Programming

Literatur:
      P. A. Henning, Taschenbuch Multimedia, Fachbuchverlag Leipzig,
         2001, Kap. 9

Multimedia Development

- Scope: Interactive multimedia applications, including distributed applications
- Typically carried out by "multimedia agencies" (Multimedia-Agenturen)
  - Main target distribution media:
    » CD/DVD-ROM
    » Web presentations (HTML technology, Flash technology)
- Position in the value chain:

Content Production	Application Production	Distribution Platform Provision
• Media industry • Traditional industry (e-commerce)	• Multimedia agencies • System integrators	• Telcos • ISPs (Internet Service Provider)

Content

- Auch im deutschsprachigen Raum als Fremdwort benutzt!
  - „Inhalt" im Sinne eines zu übermittelnden Guts
- *Content* in media delivery chains:
  - Often has its own market value (music, movie)
  - Often associated with products of commercial value (Product description in e–commerce)
  - Value chains within content production can be rather complex in themselves
- *Content Provider:*
  - Separate organisation specialized in delivering (and possibly also producing) content

- Remarks:
  - Content of high value can be difficult to obtain for (academic & research) experiments!
  - Judge the results of experiments also due to the quality of the used content!
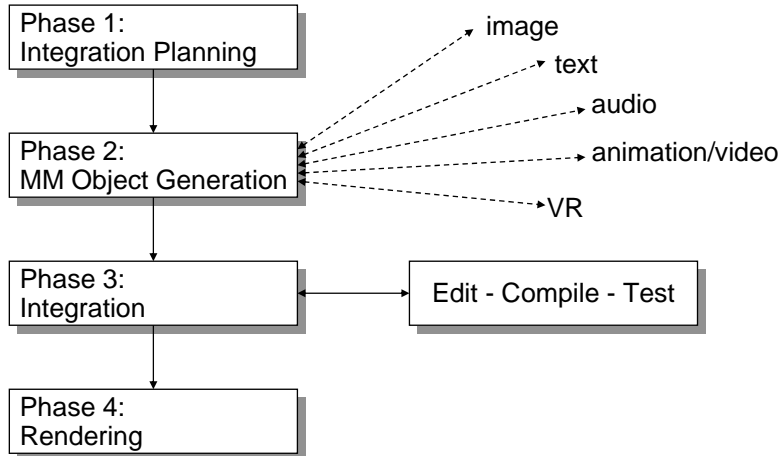
The Design Dilemma

- There are at least three different kinds of *design* involved in a multimedia project:
  - **Media Design**
    - » Visual Design (still image & video), Audio Design
    - » Extremely complex, specialists available
  - **Software Design**
    - » Software architecture, standard frameworks, design patterns
    - » Extremely complex, specialists available
    - » Intersection with media design specialists: almost zero
  - **Interaction Design**
    - » Man-machine interaction, usability, accessibility
    - » Complex, but only a few specialists available
    - » Intersection mostly *either* with Media Design *or* with Software Design specialists

Example: Four-Phase Multimedia Design Process

- According to Henning 2001

- ***Multimedia Object***
  - Informational unit that occupies one or more perception channels of the human being
  - E.g. text object, picture, audio sequence, VR object
- ***Multimedia Production***
  - Combination and integration of several multimedia objects into a stream of information which uses several perception channels of a human being
  - Process of combining media objects: *media integration, composing*

Four-Phase Multimedia Design Process: Overview

Phase 1:
Integration Planning

Phase 2:
MM Object Generation

→ image
→ text
→ audio
→ animation/video
→ VR

Phase 3:
Integration ← → Edit - Compile - Test

Phase 4:
Rendering

Multimedia Design Process Phase 1

Integration Planning
- Planning for the co-ordinated effect of the multimedia objects to be used
- High Level:
  - What is the desired effect on the end user?
  - Which role is played by multimedia technology?
  - Which media objects do we need / can we afford?
  - When to show what?
  - What are the possibilities of the user to intervene?
    » Interaction design
- Low Level:
  - Development of *story board*
  - Synchronisation planning
  - Planning of error handling

Multimedia Design Process Phase 2
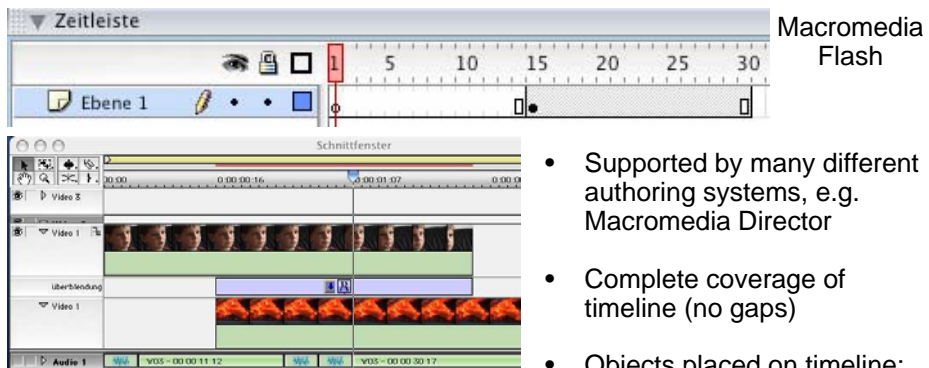
Object Generation

- Production of required media content
- Generation of a *media library* to be used in later steps
- New material:
  - Film production, music production, ...
- Legacy material:
  - Dealing with old formats
  - Dealing with copyright problems
- Adaptation of material:
  - Digital image/audio/video processing
  - E.g. (images):
    - » Format conversion
    - » Geometric, colour transformations
    - » Filtering (e.g. sharpness)

Multimedia Design Process Phase 3

Integration, Composing

- Media objects are not modified anymore
  - "Virtual" composition (e.g. movie clips in video editing software)
- Creation of a common context for individual media objects
- Integration of navigation, control and information entry elements
  - Buttons, rulers, text fields, ...
- Paradigms for media object integration:
  - Timeline-based
  - Frame-based
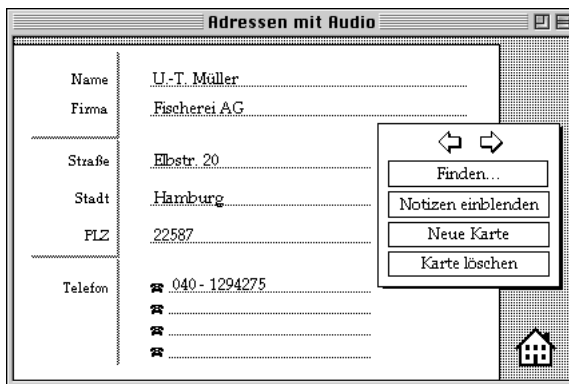 - Flowchart-based
  - Object-based

Timeline-based Media Object Integration

Macromedia Flash

Adobe Premiere

- Supported by many different authoring systems, e.g. Macromedia Director

- Complete coverage of timeline (no gaps)

- Objects placed on timeline; mainly linear user interaction (VCR-like)

- Further details required for individual objects (instances):
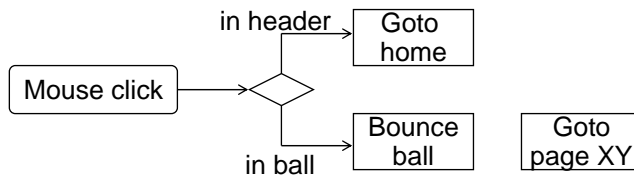 position on screen, movement, effects, …

Frame-based Media Object Integration

Apple HyperCard (1987)

- Used in text-oriented authoring systems, e.g. Asymetrix ToolBook

- Non-linear interaction: Programmed response to mouse interaction with specific regions

- Object-oriented approach

- Objects placed on screen
- Interaction carried out by event handlers
- Standard event handler components, e.g. for links
  – Hypertext-like information structure

Flowchart-based Media Object Integration

- Special case of frame-based media object integration
- Interaction style "more linear" (i.e. more limited in user options) than in hypertext style interaction
- Less object-oriented than in the frame-based approach
- Rarely used
  – Main authoring system product: Macromedia Authorware

Object-based Media Object Integration

- Traditional object-oriented programming
  – Objects paint themselves on the screen
  – Presentation sequence and interaction based on message exchange between objects
  – Graphical development metaphors unusual - mostly "pure code"
- Advantages:
  – Most powerful
  – Usage of standard programming languages
- Disadvantages:
  – Inadequate for graphical designers
  – Previewing of final product is missing - iterative development not well supported

The Design Dilemma, Contd.

- Media design
  - Well supported by special tools for multimedia object generation
  - Well supported in frame-based integration
- Software design   **Problem #1**
  - Apparently in competition with media design
    - » Frame-based integration scatters code to many places, is an obstacle for good software design
    - » Object-based integration is an obstacle for good media design
- Interaction design
  - Well supported by timeline-based integration tools and flowchart-based integration tools
    - » However, only for very simple forms of interaction!
- We are missing a stage in which all three kinds of design are interwoven
  Problem #2

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1 Development process for multimedia projects

1.1   Classical models of the software development process

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1.3   Example: The SMART process

1.4   Agile development and Extreme Programming

Literatur:
> K. Osswald: Konzeptmanagement. Interaktive Medien – interdisziplinäre Projekte, Springer 2003

> (Since this source is in German, the following slides are in German language as well.)

Schlüsselbegriff: Konzept

- *„Konzept:* 1. [stichwortartiger] Entwurf, erste Fassung einer Rede oder einer Schrift. 2. Plan, Programm"

  (Duden-Fremdwörterbuch, 1994)

- Begriff aus der Literaturwissenschaft, übertragen auf die Medien- und Werbebranche

- Konzeption = Erstellen eines Konzepts:
  - Aufbauend auf nur wenigen Grundinformationen
  - Kernaspekte einer konkreten Anwendung festlegen und veranschaulichen
  - Beschreibung aller Komponenten, die für die Realisierung notwendig sind

- Formalisierung:
  - Konzept kann „in den Köpfen" der beteiligten Mitarbeiter existieren
  - Konzept kann detailliert, z.B. als Antwort auf eine Ausschreibung, ausgearbeitet sein

- Erfolgreiche Konzeption ist nur im Zusammenspiel der verschiedenen Design-Arten möglich!

Nicht-technische Tätigkeitsfelder in Multimedia-Projekten

- Konzeption
  - Hoch kreative Tätigkeit
  - Grobkonzept entwickeln und Umsetzung in Feinkonzept betreuen
  - Typische Aufgabe für ein interdisziplinäres Team

- (Medien-)Design
  - Gestalterische Umsetzung der Anwendung in Bild und Ton
  - Durch moderne Interaktionstechnologien Grenze zum Interaktions- und Softwaredesign verschwimmend

- Redaktion
  - Verfassen und Zusammenstellen von Content-Bestandteilen
  - Content-Akquisition, Lizensierung

- Information Broking
  - Recherche von spezifischen Fragestellungen in Datenbanken und Bibliotheken

Technische Tätigkeitsfelder
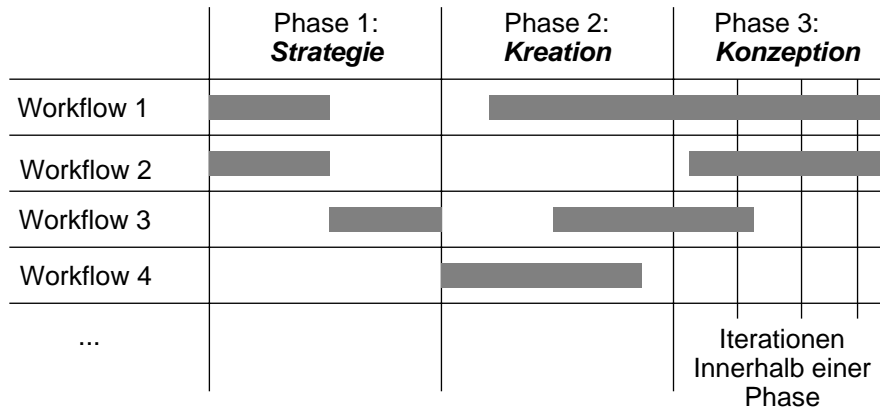# in Multimedia-Projekten

- Projektmanagement
    - Koordination und Abwicklung einer Produktion
    - Management und Controlling
    - Schnittstelle zwischen Kunde und Produktionsteam
    - Häufig auch intensiv an der Konzeption beteiligt

- Programmierung
    - Umsetzung der Konzepte in Programmiersprachen und Autorensystemen
    - Klassischer (und eher für Großunternehmen geeigneter) Ansatz:
        » Technische Spezialisten erst in späten Projektphasen beteiligt
    - Trend:
        » Technische und grafische Sichtweisen möglichst früh in die
          Konzeptarbeit integrieren (Osswald S. 29)

SMART-Modell

- Rahmenwerk zur Vorgehensplanung bei Multimedia-Projekten
                                                    (Kerstin Osswald 2003)

- **S**kalierbar
- **M**ultimedia
- **A**ufgabenplanung
- **R**essourcenplanung
- **T**ool

- Iterative Entwicklungsmethode, am Rational Unified Process orientiert

SMART: Überblick

- SMART definiert 3 Phasen und betrachtet viele parallele Workflows über diese Phasen

	Phase 1: *Strategie*	Phase 2: *Kreation*	Phase 3: *Konzeption*
Workflow 1	�████	██████████	██████████
Workflow 2	�████		██████
Workflow 3	███	████	
Workflow 4		████	
...			Iterationen Innerhalb einer Phase

SMART: Workflows

- Anforderungsmanagement
- Strategieentwicklung
- Ideenfindung auf Metaebene
- Definition der Funktionalitäten
- Redaktion
- Informationsarchitektur
- Grafisches Konzept
- Technisches Konzept
- Zeit- und Kostenmanagement
- Qualitätsmanagement

(prinzipiell anpassbar an spezifische Gegebenheiten)

SMART: Artefakte (1)

- Angebot
- Anwendungsfallprotokoll
- Anwendungsfallübersicht
- Benchmark-Analyse
- Benutzerprofil
- Brand Bible
- Change Request
- Containerprofil
- Content Management Plan
- Contentogramm
- Content Writing Styleguide
- Creative Brief
- Datenbankarchitektur
- Designvorschlag
- Modulprofil
- Moodboard/Komposition/Skizze
- Navigationskonzept
- Phasenplan
- Production Board
- Prototyp
- Programmierspezifikation
- Rebriefing/Strategic Brief
- Risikoanalyse
- Screenverzeichnis
- Seitengrundraster
- Seitentypdefinition
- Site Map
- Storyboard/Drehbuch
- Dialogdummy
- Dienstleistermotivation

SMART: Artefakte (2)

- Erfolgsmatrix
- Feasibility-Analyse
- Flussdiagramm
- Funktionsspezifikation
- Geschäftszieltabelle
- Graphical Strategic Brief
- Interactive Media Storyboard
- Investitionsempfehlung
- Iterationsplan
- Kostenvoranschlag
- Mission Statement
- Mitarbeitermotivation
- Szenario
- Technical Strategic Brief
- Technischer Überblick
- Technische Spezifikation
- Usability-Analyse
- Vision
- Visual Design Styleguide
- Zieldefinition

SMART: Phasen

- Idee der Trennung von Grob- und Feinentwurf wegen laufender Änderungswünsche nicht realisierbar
- Bessere Trennung: Ziele, kreative Idee, Erarbeitung von Inhalten
- ***Strategie:***
  - Abstraktion, Zerkleinerung
  - Definition des (über die Projektlaufzeit stabilen!) Problems
  - Strukturierung, Hypothesenbildung
- ***Kreation:***
  - Produktion möglichst vieler verwertbarer Ideen (unabhängig vom Kunden!)
  - Entwicklung einer interdisziplinären Vision für den Projektverlauf
- ***Konzeption:***
  - Kritische Prüfung entstandener Ideen
  - Disziplinübergreifende Ausarbeitung von ausgewählten Ideen

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SMART: Zuordnung von Workflows zu Phasen

	Phase 1: *Strategie*	Phase 2: *Kreation*	Phase 3: *Konzeption*		
Iteration	1	2	3	4	5
Anforderungsmanagement	▓		▓	▓	▓
Strategieentwicklung	▓		▓		
Ideenfindung auf Metaebene		▓	▪		▪
Definition der Funktionalitäten			▓	▓	▓
Redaktion			▓	▓	
Informationsarchitektur				▓	▓
Grafisches Konzept				▓	▓
Technisches Konzept			▓		▓
Zeit- und Kostenmanagement	▓	▓	▓	▓	▓
Qualitätsmanagement	▓	▓	▓	▓	▓

Beispielhaft, aber typisch!

SMART: Typische Rollen (Auswahl)

- Art Director:
  - Überwacht Konzeption und Gestaltung, erstellt Interaktionskonzepte
  - Arbeitet eng zusammen mit Screendesigner, Konzepter, Softwareentw.
- Creative Director:
  - Überwacht die Stimmigkeit aller Konzepte und hinterfragt Entscheidungen
  - Inhaltliche Verantwortung für kreative Arbeit, sorgt für innovativen Input
- Screendesigner:
  - Entwickelt „Masterscreen"-Beschreibung und „Look and Feel"
  - Erstellt visuelle Konzepte und grafische Content-Elemente
  - Setzt Corporate Design des Kunden um
- Frontend/Backend Programmierer:
  - Frontend: Clientseitige Programmierung, meist Dialogdummies
  - Backend: Anwendungslogik, Datenbankanbindung, Middleware

SMART-Konfiguration

- Für eine Organisation bzw. ein Projekt werden festgelegt:
- Welche Artefakte werden benötigt?
  - Abhängig von Anwendungsgebiet und Komplexität in den verschiedenen Aspekten
  - Beispiele von Projektcharakteristika: Statisch/Dynamisch/Prozesse/Bewegtbild
- Welche Rollen werden benötigt?
  - Jedes Artefakt ist (fest definiert) mit bestimmten Qualifikationen zu seiner Herstellung verknüpft.
- Definition der Zuordnung von Workflows zu Phasen
  - Anpassung des beispielhaften Basis-Modells (siehe oben)
  - Berücksichtigung der zu erstellenden Artefakte

- ... Für Details siehe Osswald 2003!

Preliminary Conclusion

- Multimedia projects involve significantly more workflows and roles than traditional software development projects.
- The integration among various disciplines is particularly important during the early phases (strategy and creative conception).
- Even the most advanced, iteratively organized, development methods stay relatively close to the waterfall idea.
- It is a commonly accepted truth that requirement changes of all kinds take place during the development period of any project, in particular a multimedia project.
- Consequence:
  - Let's try to "embrace change" (Quotation: Kent Beck)
  - Technology shall be helpful in managing continuous change.