

# Multimedia-Programmierung

Heinrich Hußmann  
Ludwig-Maximilians-Universität München  
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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

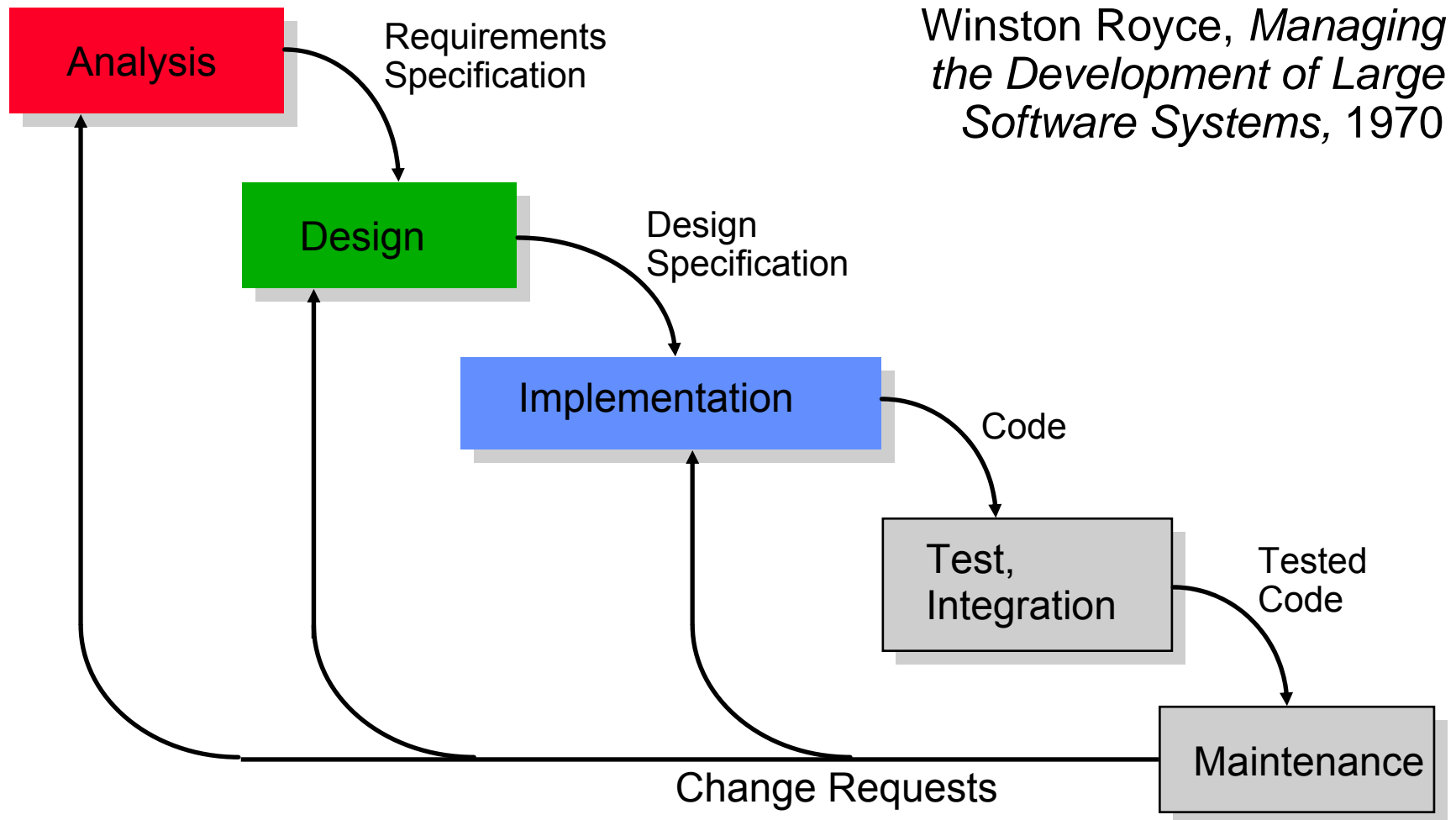
# 1 Development process for multimedia projects

- 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

## Literature:

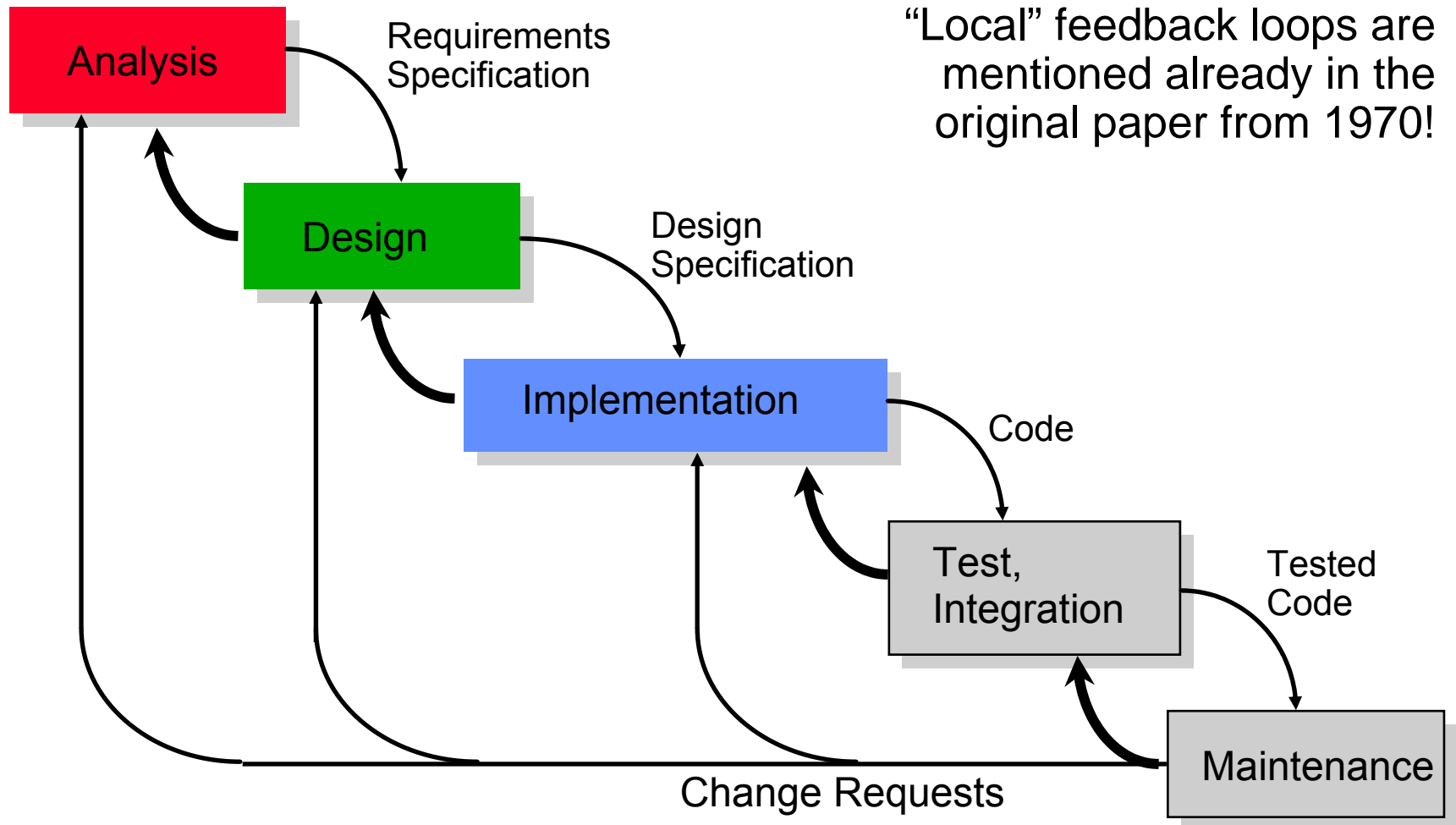
- Any textbook on Software Engineering.
- M. & T. Poppendieck: Lean Software Development, Addison-Wesley 2003
- K. Osswald: Konzeptmanagement. Interaktive Medien – interdisziplinäre Projekte, Springer 2003

# The “Waterfall” Model - Textbook Version



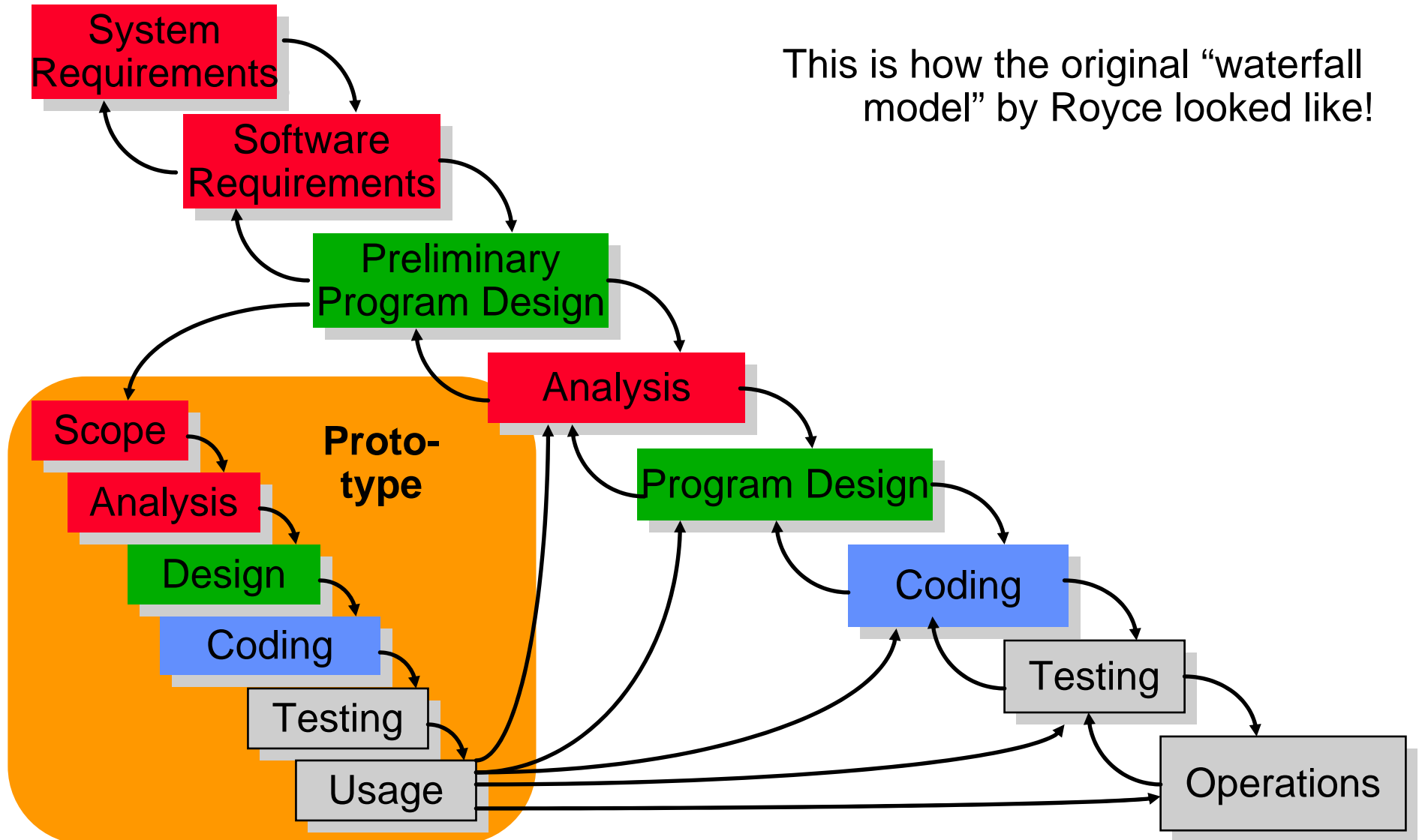


# “Waterfall” Feedback Loop #1: Quality Control



# “Waterfall” Feedback Loop #2: Prototyping

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



# A Modern Iterative/Incremental Process: Rational Unified Process

## Phases

### Core Process Workflows

Business Modeling

Requirements

Analysis & Design

Implementation

Test

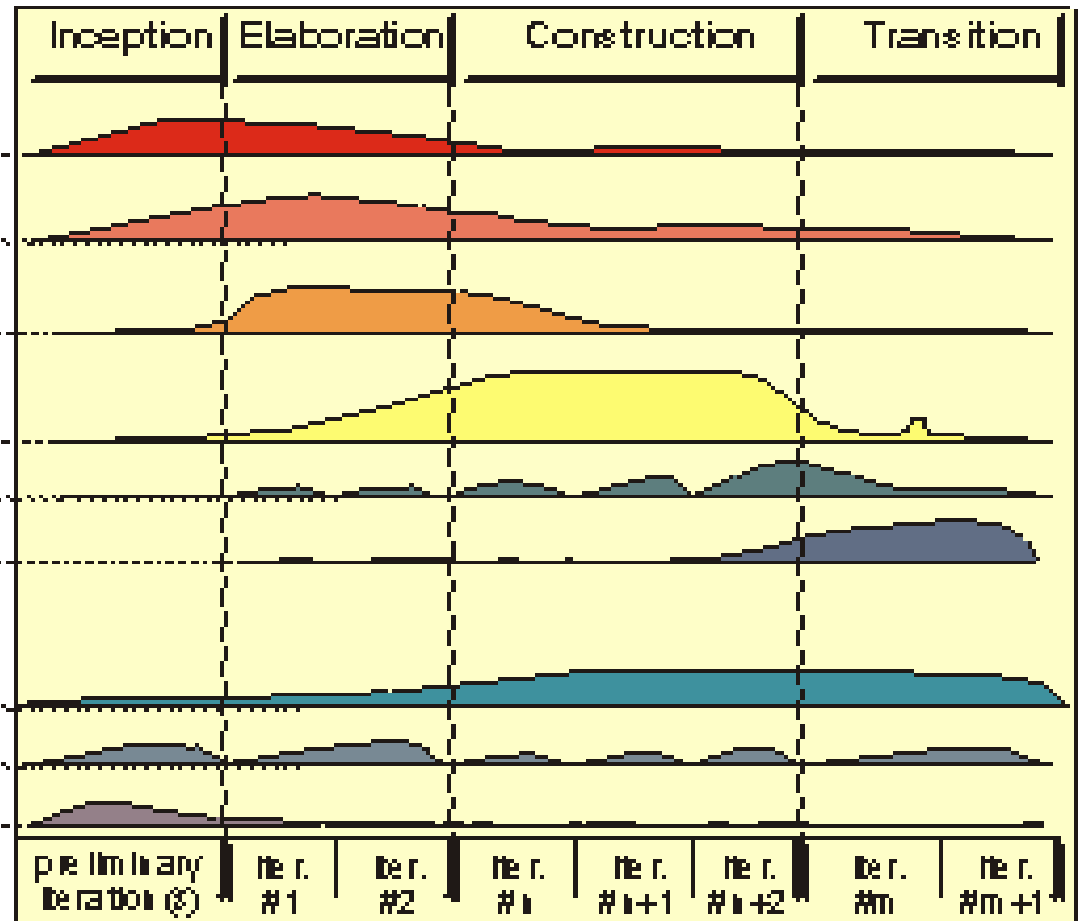
Deployment

### Core Supporting Workflows

Configuration & Change Mgmt.

Project Management

Environment



## Iterations

# 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

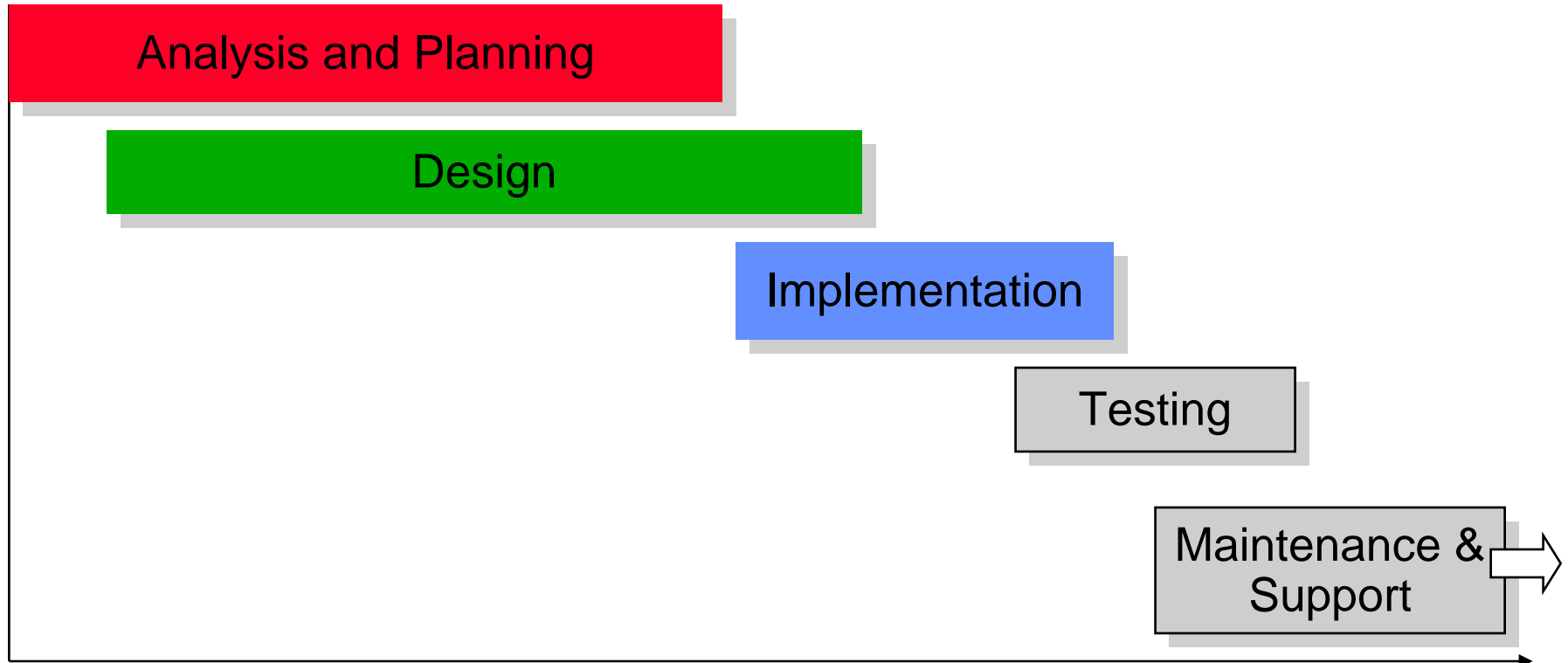
- Fred Brooks, 1975: “Plan to throw one away; you will anyhow.”
- David Lamb, 1988: Software engineering is “planning for change”
- Lessons learnt from traditional software engineering at this point:
  - *Iteration* is a key principle in all variants of the development process (from waterfall to modern 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



# 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
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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:



- 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!

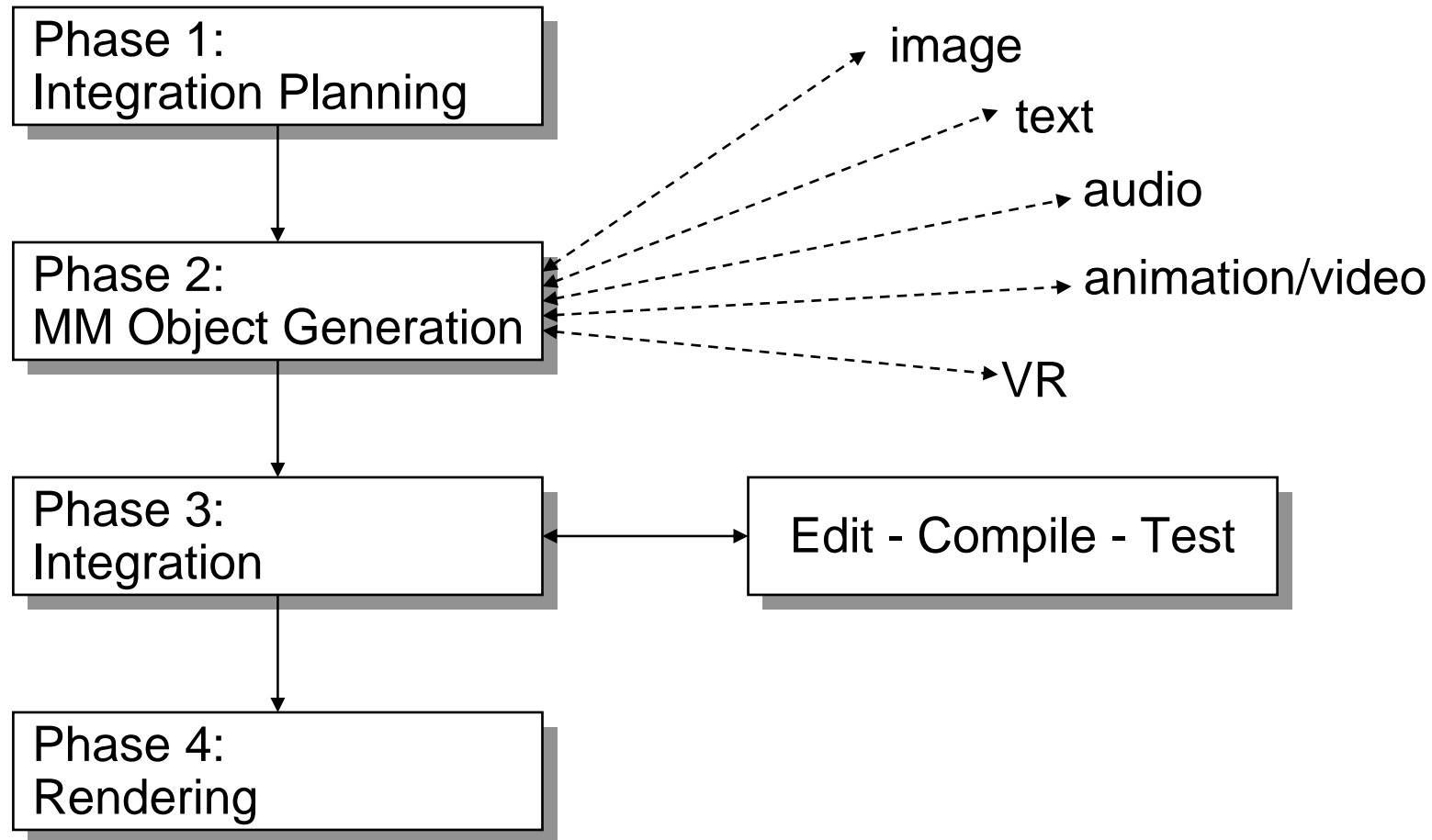
# The Design Dilemma

- 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



# 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)

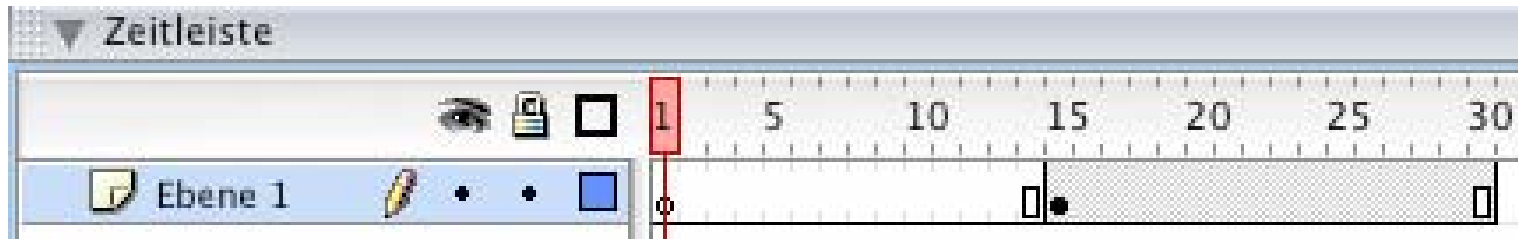
# Multimedia Design Process Phase 3

## 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



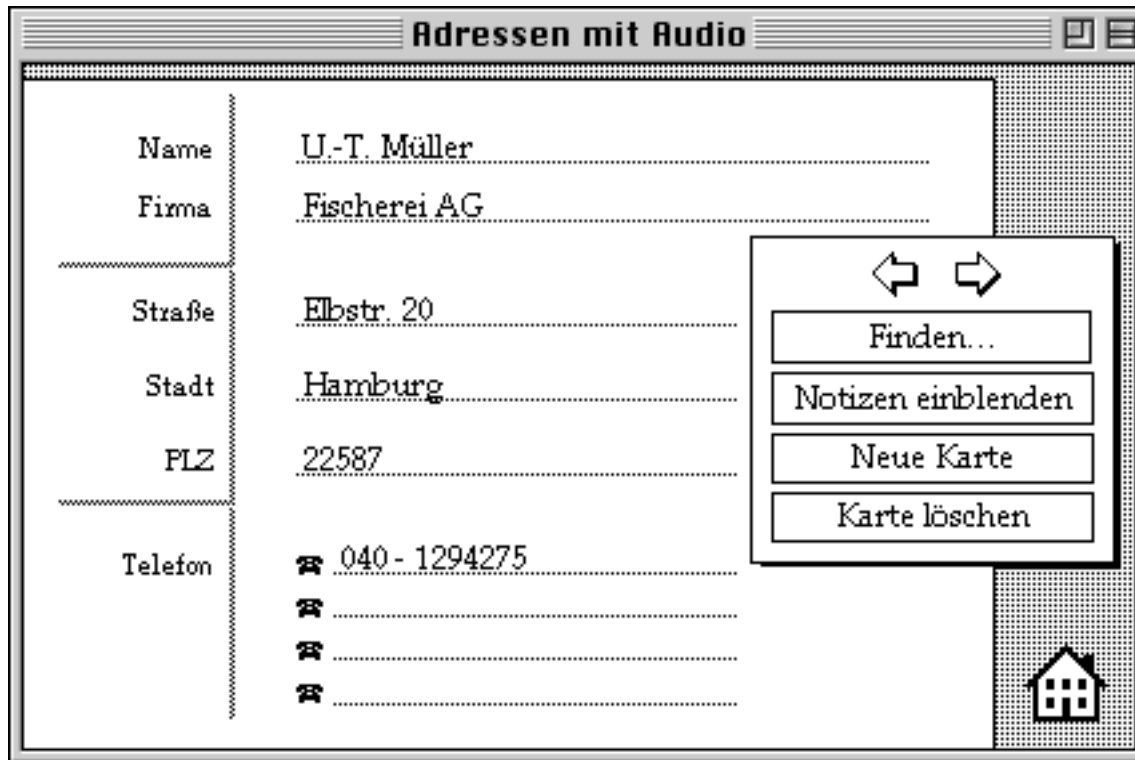
Macromedia  
Flash



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

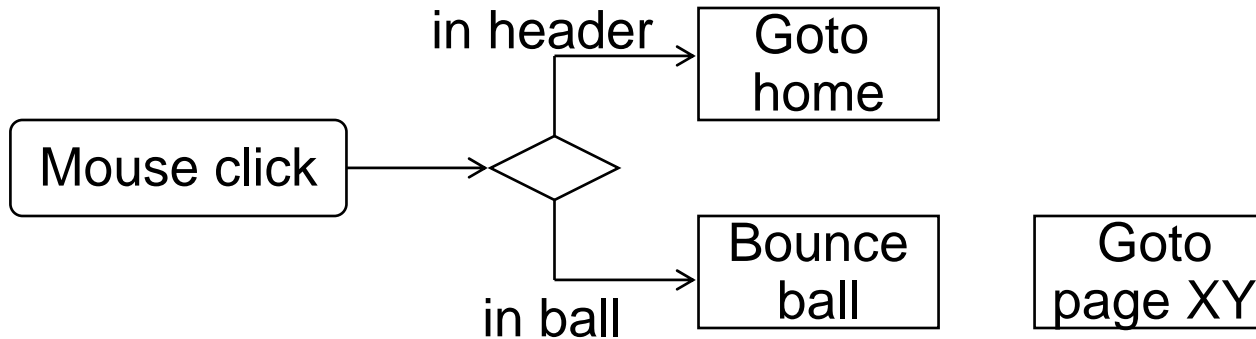


Apple HyperCard (1987)

- 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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## 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, Lizenzierung
- Information Broking
  - Recherche von spezifischen Fragestellungen in Datenbanken und Bibliotheken



# Technische Tätigkeitsfelder in Multimedia-Projekten

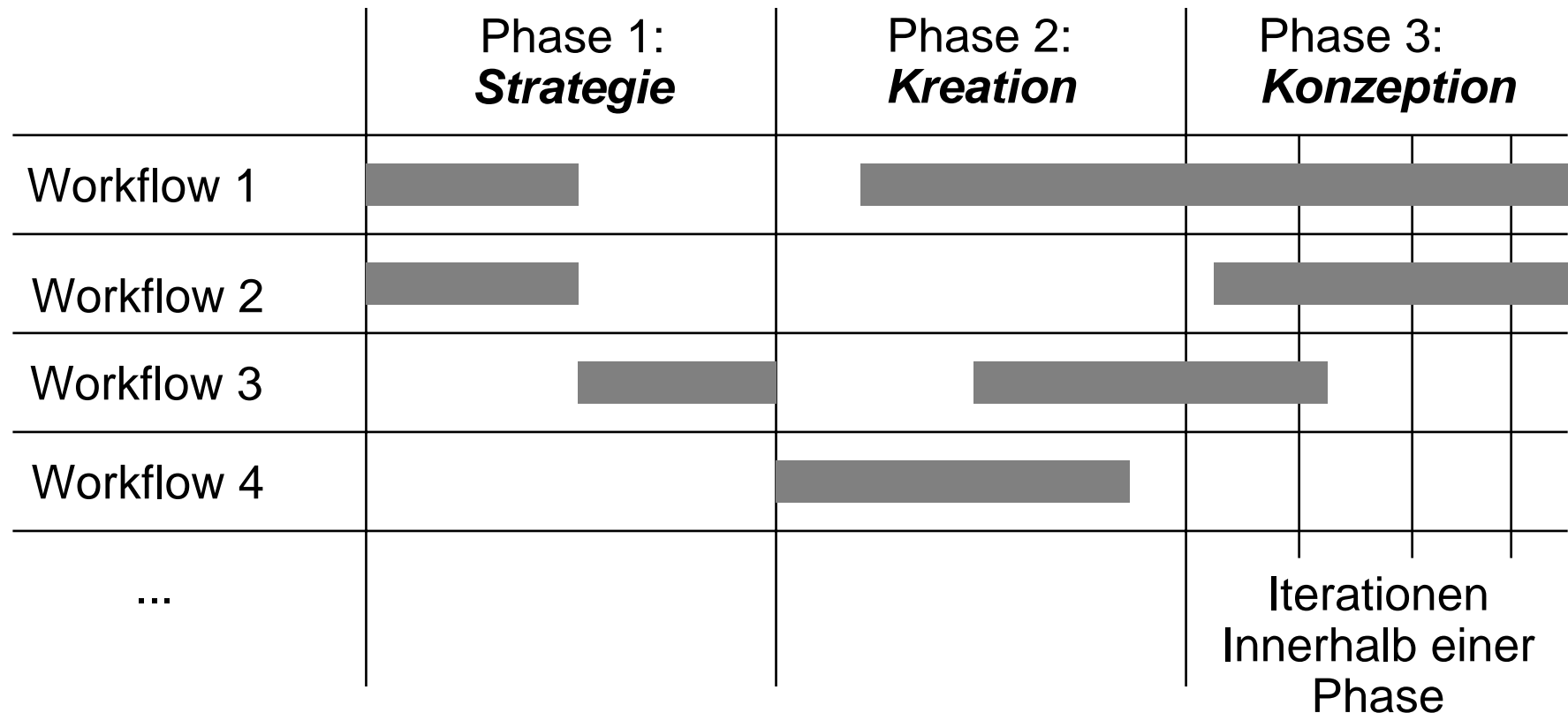
- Projektmanagement
  - Koordination und Abwicklung einer Produktion
  - Management und Controlling
  - Schnittstelle zwischen Kunde und Produktionsteam
  - Häufig auch intensiv an der Konzeption beteiligt
- Programmierung
  - Umsetzung der Konzepte in Programmiersprachen und Autorensystemen
  - Klassischer (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



# 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

# SMART: Zuordnung von Workflows zu Phasen

	Phase 1: <b>Strategie</b>	Phase 2: <b>Kreation</b>	Phase 3: <b>Konzeption</b>		
<i>Iteration</i>	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, Datenbankbindung, 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.