Session 9: Episode 3(1) —
Cognitive tools for the individual

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Access my research papers from Google Citations

Tonight

- Personal computers give individuals cognitive tools to convert thoughts into explicit electronically realized objects that can be independently stored, copied, communicated, retrieved, shared and even processed semantically.

EPISODE 3 - Cognitive Tools for Individuals
Tools to Capture Knowledge
    Word processing (extending the paradigm of paper)
    Calculators and spreadsheets (extending the paradigm of a paper spreadsheet)
    Databases (extending the tabular paradigm to more than two dimensions)
    Paper Paradigms and Microsoft's Waning Dominance of Personal Computing
   Structured Authoring Adds Computer Readable Syntax and Semantics to Text
    Typesetting Markup
    Structural and Semantic Markup (Enabling the Structural Paradigm)

- Killer applications on personal computers fundamentally changed how humans form, codify, preserve, and communicate knowledge
  - Thoughts to documents
  - Data to information
  - Information to relationships

  } → Symbols → content → semantics

Tools to assemble, present and preserve knowledge

- For 6+ millenia until 1980s, documents were tangible
  - Visible codes or artwork applied to a surface only contained meaning for the (literate) human viewer
- Beginning in the 1980s, the use of computers by humans to electronically encode their knowledge and thoughts radically changed the nature of documents and how humans can interact with them.
  - Many older people still consider the electronic version of the document to be irrelevant by comparison to the paper version
  - "the only real document is paper" = the **paper document paradigm**
- Today virtually all documentation is produced electronically
  - Electronic documents are "virtual" = the **virtual document paradigm**
  - Virtual documents can be endlessly duplicated, distributed, & retrieved at light speed for essentially no cost
  - Virtual documents can be meaningfully processed by computers
- New kinds of literacy required to make best of the new docs
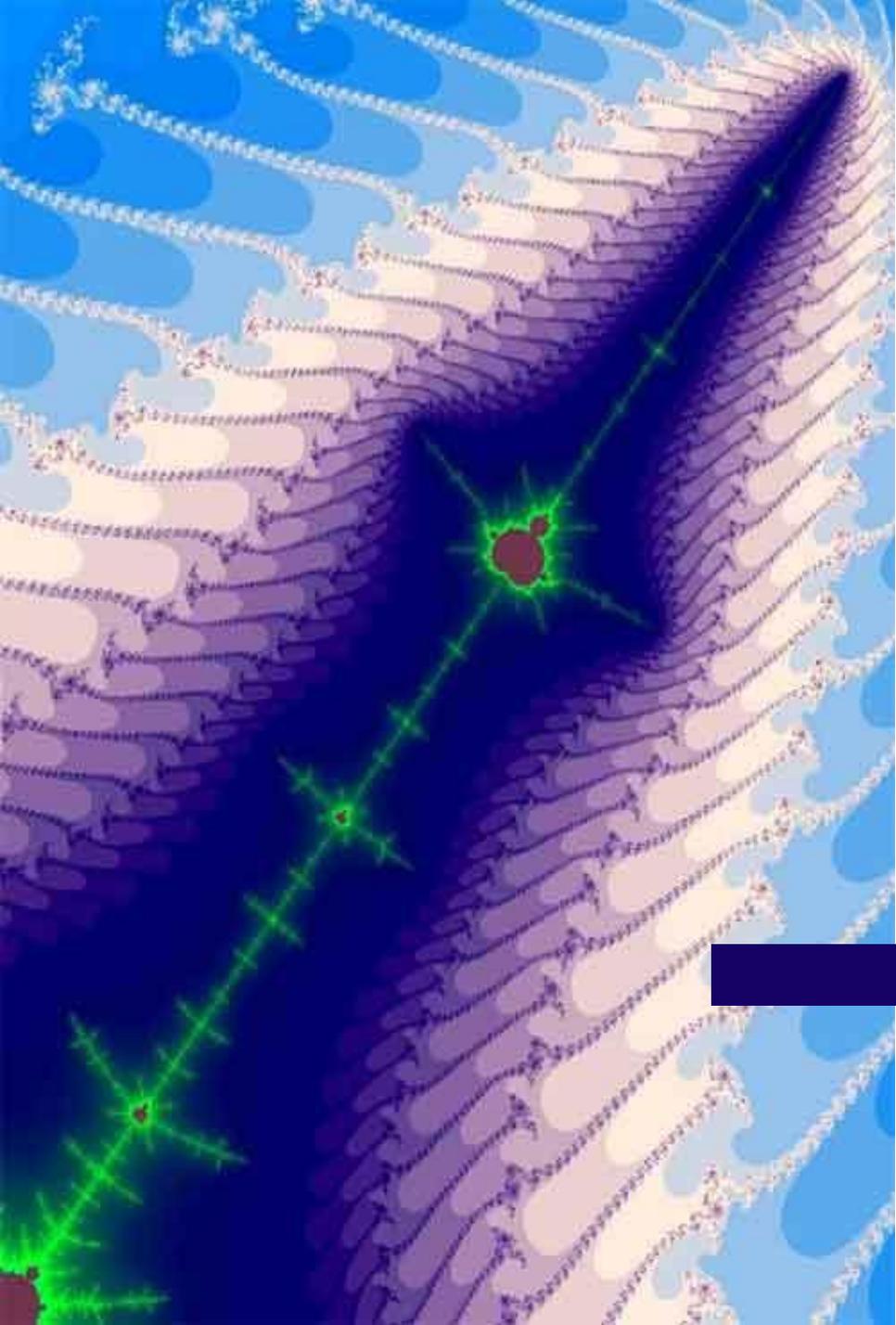
Three killer apps fundamentally changed how we make knowledge explicit

—

producing documents
working with numbers
managing information

Killer apps turn thoughts into documents

- In a paper paradigm, the author's cognition is done in World 2
  - Thoughts distilled, transformed to words, committed to paper
  - Ponderous process limited numbers of drafts & prolonged cycle times
- IBM's memory typewriters (typing input ➔ letter perfect output
  - Mag Card II (1971-1973) 800 chars of correctable text
  - Memory Typewriter (1974) ~ 50 pages of correctable text
  - Enabled storage and distribution of electronic documents
- Connecting the components of a word processor
  - Keyboard + screen + processor + electronic printer
- Word processing launched personal computing
  - Character-based
    - WordStar (1979) in the CP/M environment; IBM PC DOS (1981)
    - MS Word (~ 1983) used mouse
    - WordPerfect developed for mainframes, ported to PC (1982), began to dominate the DOS business environment from 1986
  - Mass acceptance made prices affordable for individuals

Word processing to personal publishing

- GUI and WYSIWYG
  - Xerox PARC Alto (1973)
    - 128 kb memory, WYSIWYG screen, mouse, matrix printer, 2.5 MB platter (small fridge), networked, email..
    - Non-commercial source of ideas for all subsequent practical implications
    - Paradigmatic issues limited commercial development
  - Apple Lisa (1983), Mcintosh (1984)
    - First commercial (but still expensive) implementations
    - Technically and conceptually superior designs
  - MS Word for Windows (1990) full GUI implementation
- Desk top publishing
  - Easy combination of text, tables, and graphics
    - Cutting, pasting, book marking, linking, automatic indexing etc.
  - Increasingly high quality multi-color printing (dot matrix, laser, ink jet)
  - Electronic distribution to high resolution reading devices
- Individual literacy now includes keyboarding, composing and publishing (typing is now an extinct employment category)

Killer apps turn data into information

- Books of accounts, spreadsheets and other tabulated data
  - Sees the financial activities of a business as columns and rows
    - Automated calculation of a variety of functions
    - Calculations take place in seconds rather than minutes or hours
    - Mainframe applications replace card sorters since early 60's for orgs
- Personal spreadsheets turn PCs into accounting machines
  - VisiCalc (1979) puts spreadsheet on personal desks
  - Lotus 1-2-3 (1983) adds graphing
  - Faster, but didn't change basic paper paradigm of columns & rows
  - Development of extensions for engineering, science, maths, etc.
- Facilitated development of the home office and new ways of doing business

Adding dimensions and relationships to information

- Large organizations maintained accounting, inventory, personnel and other databases on mainframe computers since the 1960s
  - Collections of tables
    - Maintained by MIS departments with data input by clerical depts
    - Computers maintaining various indexes against particular columns
- Relational database concept developed (E.F. Codd 1969, 1970)
  - Collection of related tables, where each table contains entries to tightly specified types of information
    - Each line uniquely identified (primary key)
    - May have additional (alternative) keys also uniquely identifying each row
    - Join tables identify relationships (1 to 1, 1 to many, many to many)
  - Operations (4 types of set operations, 4 operations specific to relational databases)
  - RDB systems semantically understand and operate on the relationships of datasets defining organizational operations
  - Normalization eliminates repetition of information (e.g. customer name and address) across different tables (**write once use many times**)
- Single entrepreneurs able to manage large operations!

Developing database management systems for the desktop

- Oracle Corp. founded 1977 to address main-frame market
- Vulcan (1979)/Ashton-Tate dBase II (1982)
  - User defined relational tables
  - High level (4th gen) programming language for constructing applications to assist collection & processing of data
  - Opportunities for managing information in qualitatively new ways
- Small businesses could compete very effectively with large commercial and government organizations previously dependent on large clerical staff
- Comparable tools developed for geometrical & graphical applications (e.g., engineering design/drawing), mathematical modelling, etc
  - First for mainframes
  - Soon followed for single-user desktops
- Virtual knowledge objects can be communicated at light speed
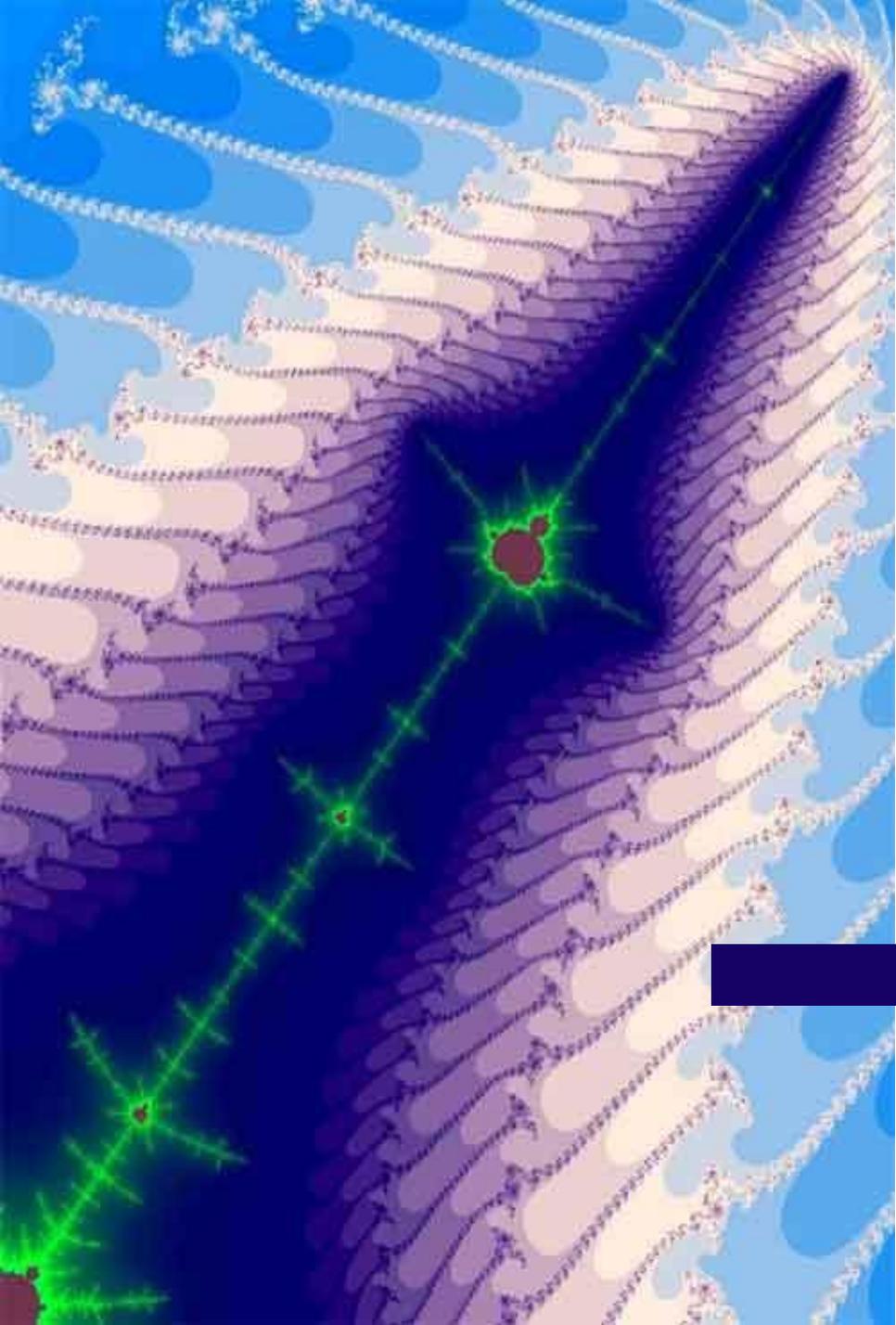
Paradigms,
holy wars over applications,
and
contests for the marketplace

The war for better "paper"

- What is a document?
  - The definitive manifestation of a particular set of information
  - An ephemeral representation of a dynamic body of information at a particular time and place
- Aggregating data and authoring/delivering in electronic docs can fundamentally change nature of knowledge work
  - Quantitatively, computers replaced typing/clerical work
  - Qualitatively, computer processing of semantically identified content can extend/replace many functions of human cognition
- The rise of Microsoft Word & other paper paradigm products
  - WYSIWYG GUI emulated the appearance of a paper document
    - Microsoft catered to the paper paradigm & those who knew no better
    - Networks used to distribute "paper" electronically
    - Incommensurable data formats forced conformity on those sharing docs
    - Microsoft's critical mass + "Network effect" wiped out competition
  - Networks used to distribute paper electronically
  - Feature wars made Word notoriously buggy
- Hidden management issues of legacy, version control, and network externality

"Printers markup": word processing, & semantics

- **Markup**: originally handwritten editorial notes and codes on a manuscript or typescript telling a typesetter how to set text for the printed page.
- **Automated typesetting, word processing / format orientated markup**: Code applied to the electronic document to control how the computer should display or print designated parts of the document (e.g., white space & line breaks, normal text, type fonts, styles, etc.).
  - How the markup is encoded and processed is entirely proprietary to each application.
  - Excepting a few early WP systems (e.g., Wordstar, WordPerfect) markup code is never visible to the user, which may make it difficult to resolve formatting errors and clashes resulting from conflicting markup.
- **Structural / semantic markup:** Bits of code applied to the electronic document that identify the different kinds of components forming the hierarchical structure of the document (e.g., titles, headings, sections, paragraphs, definitions, etc.), or even semantically different parts of the document down to sentence, or even word level.
  - Depending on the kinds of code, the computer can understand and even validate or transform the different elements in the logical structure of the document.
  - Print formats can be applied in standard ways to the different elements.

The war over paper vs structure

- Word processors encode text for formatting
  - Many, often incommensurable, ways to achieve same appearance
  - Hugely complex applications make document conversion unreliable(!)
- Structured authoring adds encodes syntax and semantics in text
  - Independent of proprietary word processing codification
  - Document structures can be parsed by computers
    - For application of formats in a meaningful way
    - For intelligent processing of semantic content
- ISO standard for SGML (ASCII encoded markup)
  - Declaration – metadata relating to a particular document type
  - DTD – a formal definition of how a conforming document may be structured and marked up in terms of element sequence/hierarchy
    - Elements (components of information/content)
    - Attributes (modifiers & metadata relating to specific elements)
    - Character references (used to call up unusual characters for printing)
    - Comments (human readable explanation of usage, etc.)
    - Element declarations define/model allowed nested content)
  - Instances – the marked up contents of documents conforming to a particular DTD
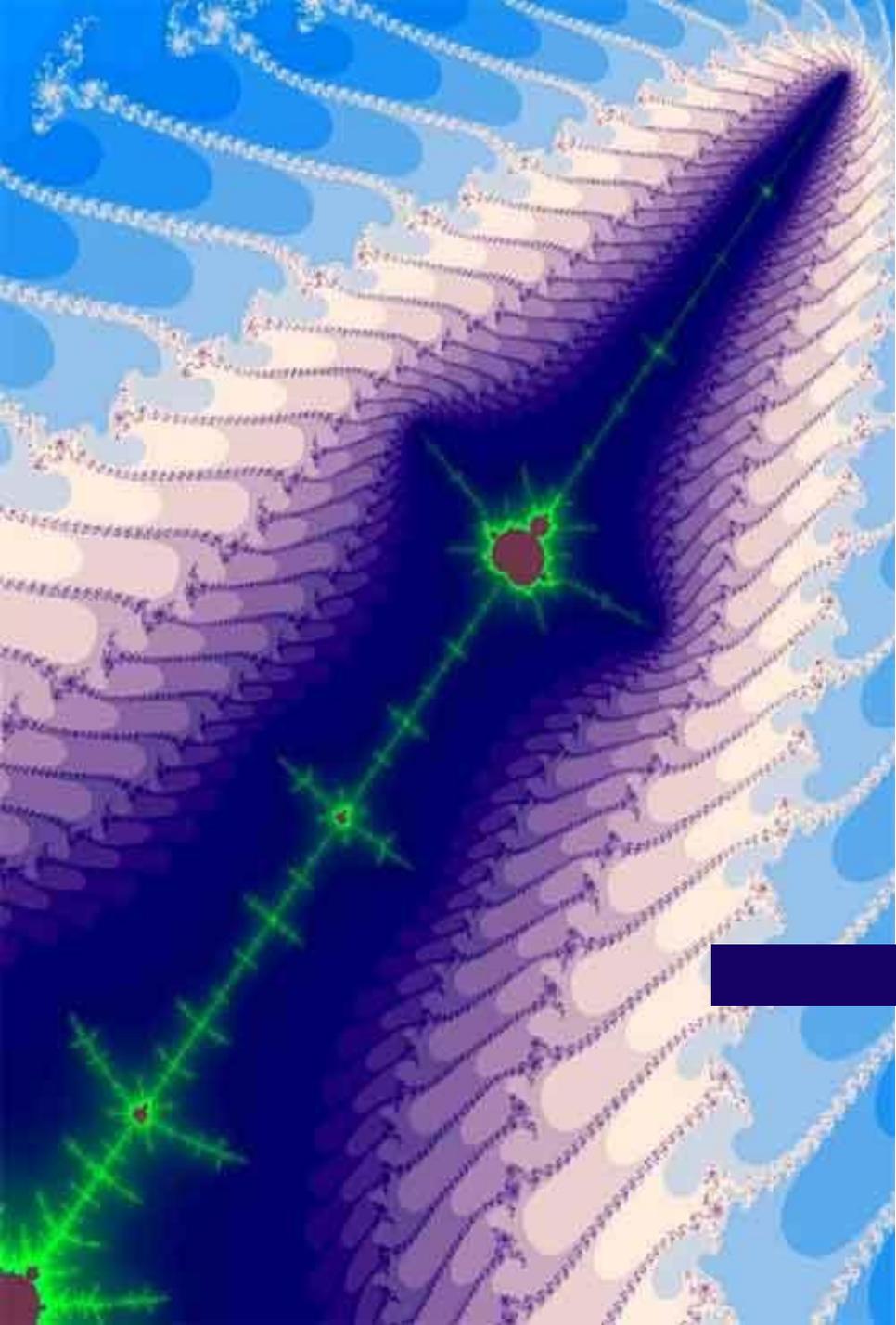
Sample elements from a DTD

- Primary paragraph element definition from the DTD for a technical maintenance document with a hierarchical structure
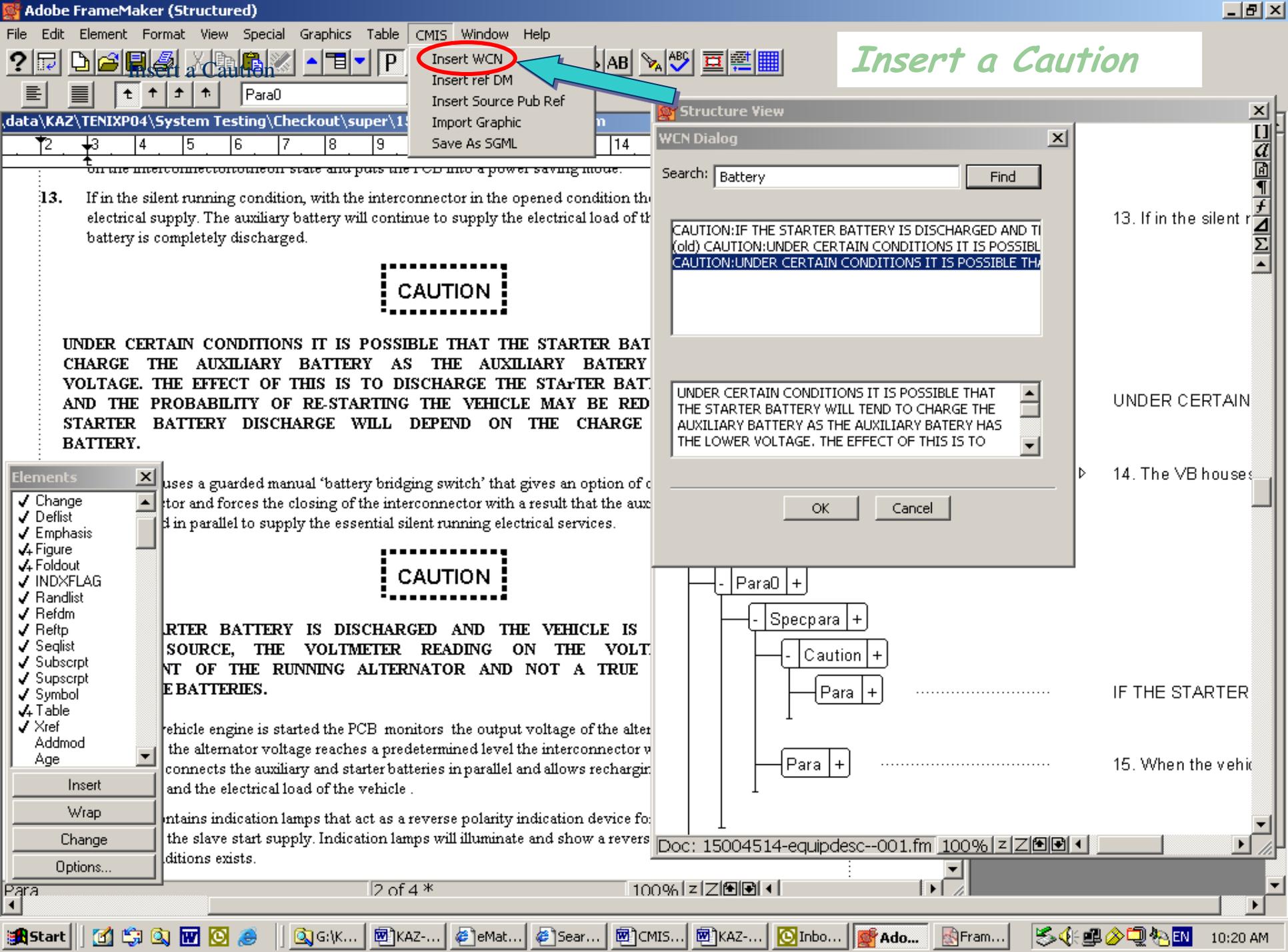
```
<!--***** PARA0(Primary Paragraph)
*************************************************************-->

<!ELEMENT PARA0      - o
((((title,shorttitle?,warning*,caution*,note*)|(((warning+,caution*,note*)|(caution
+,note*)|note+),(title,shorttitle?)?))?,para+,note*,(step1,step1+)?),(subpara1.grp|
subpara1)*)>

<!ATTLIST PARA0
                         applicrefid    IDREFS         #IMPLIED
                         assocfig       IDREFS         #IMPLIED
                         assoctab       IDREFS         #IMPLIED
                         compon         CDATA          #IMPLIED
                         contype        (desc|proc)    #IMPLIED
...
```

- Content model determines relationships amongst contained elements
  - (...)   Specifies a group.
  - A | B   Both A and B are permitted in any order.
  - A , B   A must occur before B.
  - A & B   A and B must both occur once, but may do so in any order.
  - A?   A can occur zero or one times
  - A*   A can occur zero or more times
  - A+   A can occur one or more times

Using structured authoring in practice

Documentation for a major project

Project A Design Study → RFT → Project A Bid Documents → Bid and Negotiate → Project A Prime Contract

Review, edit, signoff — Review, edit, signoff — Review, negotiate, amend

Project A Procedures, Design Docs

RFQ, Bid, Negotiate

Project B Design Study

Review, edit, signoff

Project A Support Documents

Review, negotiate, amend

Project A Subcontracts

Operational experience

Review, edit, signoff

- **20 - 50 year lifecycle**

Adobe FrameMaker (Structured)

File Edit Element Format View Special Graphics Table CMIS Window Help

Insert a Caution

CMIS menu:
- Insert WCN
- Insert ref DM
- Insert Source Pub Ref
- Import Graphic
- Save As SGML

Insert a Caution

.data\KAZ\TENIXP04\System Testing\Checkout\super\1

Para0

2   3   4   5   6   7   8   9   14

on the interconnectortotheon state and puts the PCB into a power saving mode.

13. If in the silent running condition, with the interconnector in the opened condition th
electrical supply. The auxiliary battery will continue to supply the electrical load of th
battery is completely discharged.

CAUTION

UNDER CERTAIN CONDITIONS IT IS POSSIBLE THAT THE STARTER BAT
CHARGE THE AUXILIARY BATTERY AS THE AUXILIARY BATERY
VOLTAGE. THE EFFECT OF THIS IS TO DISCHARGE THE STArTER BAT.
AND THE PROBABILITY OF RE-STARTING THE VEHICLE MAY BE RED
STARTER BATTERY DISCHARGE WILL DEPEND ON THE CHARGE
BATTERY.

uses a guarded manual 'battery bridging switch' that gives an option of c
tor and forces the closing of the interconnector with a result that the aux
d in parallel to supply the essential silent running electrical services.

CAUTION

RTER BATTERY IS DISCHARGED AND THE VEHICLE IS
SOURCE, THE VOLTMETER READING ON THE VOLT
NT OF THE RUNNING ALTERNATOR AND NOT A TRUE
E BATTERIES.

vehicle engine is started the PCB monitors the output voltage of the alter
the alternator voltage reaches a predetermined level the interconnector w
connects the auxiliary and starter batteries in parallel and allows rechargin
and the electrical load of the vehicle .

ntains indication lamps that act as a reverse polarity indication device fo:
the slave start supply. Indication lamps will illuminate and show a revers
ditions exists.

Elements
- ✓ Change
- ✓ Deflist
- ✓ Emphasis
- ✓ Figure
- ✓ Foldout
- ✓ INDXFLAG
- ✓ Randlist
- ✓ Refdm
- ✓ Reftp
- ✓ Seqlist
- ✓ Subscrpt
- ✓ Supscrpt
- ✓ Symbol
- ✓ Table
- ✓ Xref
- Addmod
- Age

Insert
Wrap
Change
Options...

Para

2 of 4 *   100%

Structure View

WCN Dialog

Search: Battery   Find

CAUTION:IF THE STARTER BATTERY IS DISCHARGED AND TI
(old) CAUTION:UNDER CERTAIN CONDITIONS IT IS POSSIBL
CAUTION:UNDER CERTAIN CONDITIONS IT IS POSSIBLE THA

UNDER CERTAIN CONDITIONS IT IS POSSIBLE THAT
THE STARTER BATTERY WILL TEND TO CHARGE THE
AUXILIARY BATTERY AS THE AUXILIARY BATERY HAS
THE LOWER VOLTAGE. THE EFFECT OF THIS IS TO

OK   Cancel

13. If in the silent r

UNDER CERTAIN

14. The VB house

Para0
Specpara
Caution
Para .... IF THE STARTER
Para .... 15. When the vehic

Doc: 15004514-equipdesc--001.fm 100%

Start   G:\K... KAZ-... eMat... Sear... CMIS... KAZ-... Inbo... Ado... Fram... EN 10:20 AM

Dual language capability

Adobe FrameMaker+SGML - [O:\CLASS-513-02-0-W-2-0-R-A0000480-5().fm]

File Edit Element Format View Special Graphics Table Window Help

Body

MRC CODE: 513– 02–W–

2 –

O R MANDATORY DESIGNATION: Not-applicable

REVISION No: 5

AMPS STANDARD ACTIVITY No.: A0000480

AMPS STANDARD ACTIVITY DESCRIPTION: Perform pump turning routine.

AMPS TRIGGER:

LYUP,

CMC: SD – A – AZ G – 010PD

CMC DESCRIPTION: ENGINE ROOM VENTILATION PUMP:

CONFIGURATION No. UNITS: 2

REFERENCE PUBLICATION:

TEM 4320-0061 Seawater Cooling Pump - Machinery Space Ventilation Both

LABOUR REQUIREMENTS:

1. Responsible Work Centre (ShopID): ME02 Nz
1. Responsible Work Centre (ShopID): ME05 Au
2. Est. Elapsed Time to Complete Job: 0.2

Flow: A E: Tsccode   1 of 5 *   80%

Adobe FrameMaker+SGML - [O:\CLASS-513-02-0-W-2-0-R-A0000480-5().fm]

File Edit Element Format View Special Graphics Table Window Help

Body

4240– 661420089

PROTECTOR, HEARING

29516

Both EA

PROCEDURE

Warning: All maintenance personnel must comply at all times with the relevant safety precautions in Ships and Departmental Standing Orders and applicable equipment manuals.

Warning: Ensure that all tag-out procedures are performed in accordance with Ships and Departmental Standing Orders, and BR 2000(20) - 0124.

Warning: Ensure that all tag-out procedures are performed in accordance with Ships and Departmental Standing Orders.

Warning: All personnel must wear hearing protection while in high noise areas.

Warning: Exercise caution when performing maintenance on lines and vessels containing pressurised gas or fluids.

Warning: Voltages dangerous to life exist when equipment is open and energised, or equipment is open and interlocks are bypassed. High voltage, high capacitance components may contain voltages dangerous to life.

Warning: Prolonged and repeated exposure of the skin to grease may cause dermatitis. Some grease is carcinogenic. Wear full protective clothing.

Flow: A E: Tsccode   3 of 5 *   80%

RMIT's Structured Information Manager

- Immensely capable tool saved our bacon at Tenix
  - SIM grew out of joint RMIT UoM research (now owned by SAIC)
  - Still at the core of US NSA scanning of comms content (email etc.)
- No project cost blowouts!
- Document suite accepted for Ship 5 acceptance
- Condensed 4 ship-sets of merge table files to 1 class-set (10 ships!) of 'SGML sources'
  - 2,000 routines reworked in less than 3,000 person/hours
    - Converted to SGML (automated)
    - Condensed ship specific docs to dual language fleet docs
    - Reviewed & flagged procedures for extensive rework later
    - Extensively reworked warnings, cautions, notes
    - Standardised procedure structures
    - Completed full peer review, correction & QA review/signoff
    - Towards end reduced total cycle time/doc to ~ ½ hour
  - Volume of text managed at Ship 5 delivery REDUCED 80%
  - Content delivered to client REDUCED 95%
  - Reduced change cycle time from weeks or months to hours

The wicked impacts of engineering change on technical documentation

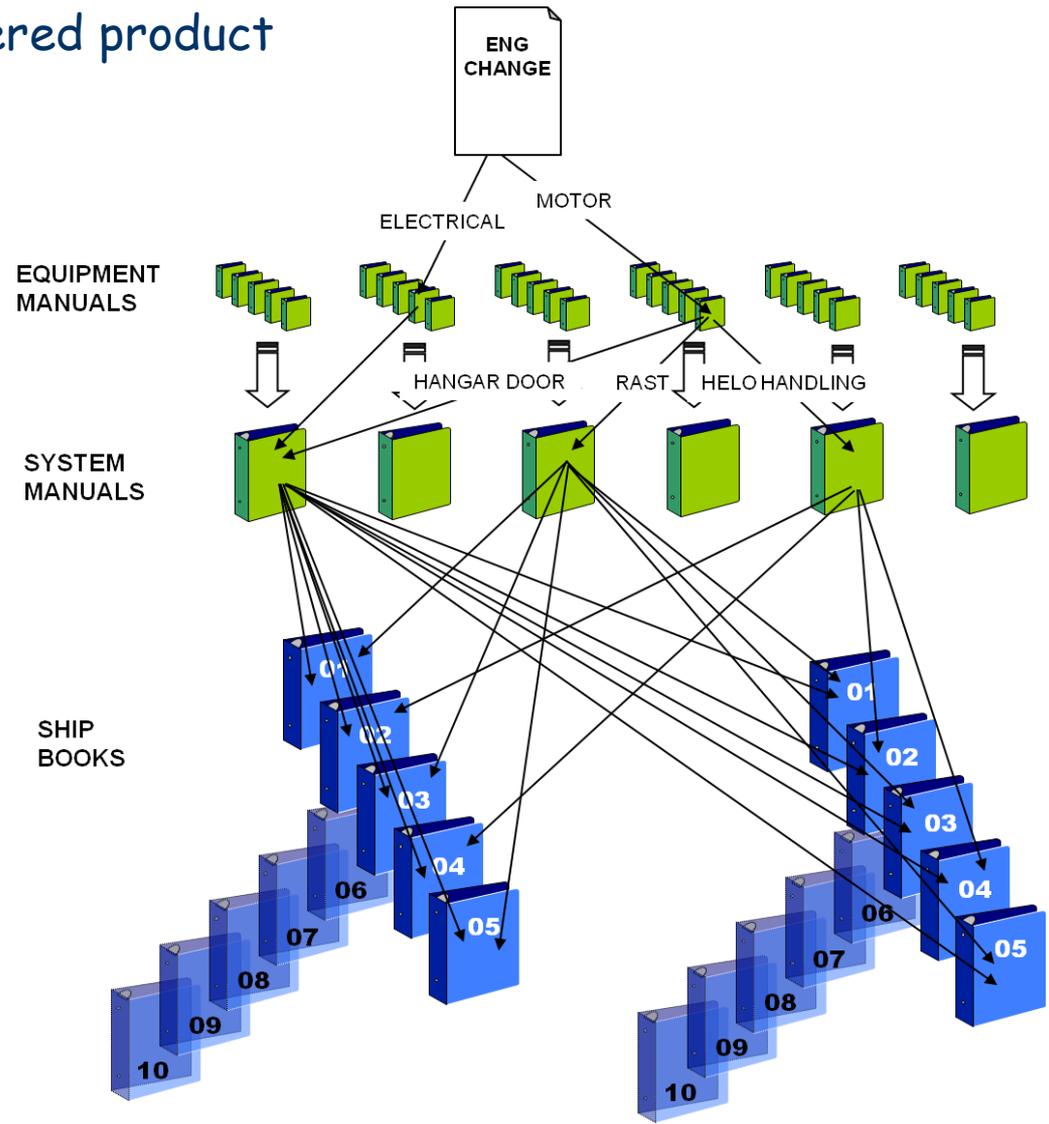- Requirements for engineered product
  - Reliable
  - Available
  - Maintainable
  - Supportable
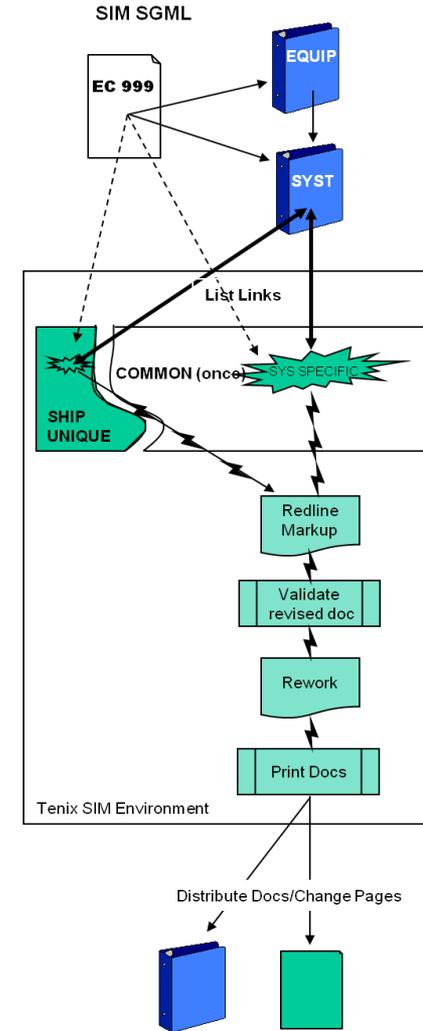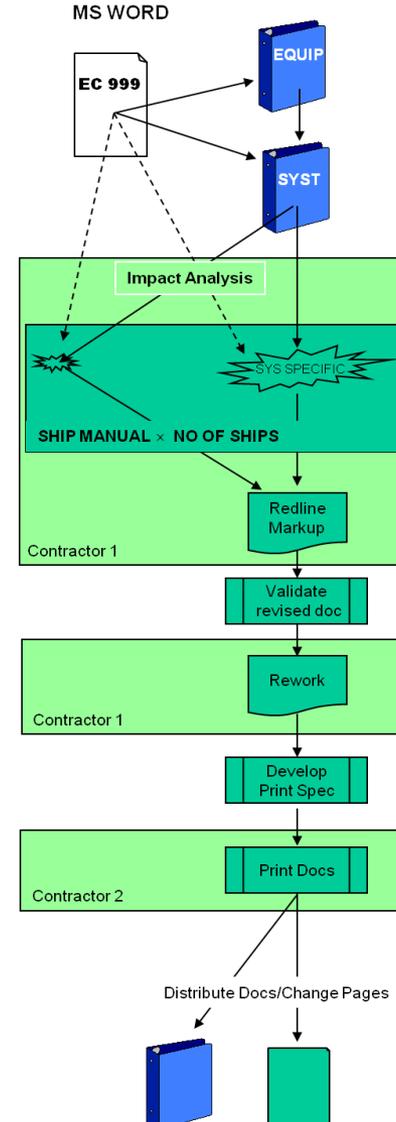 - Operable
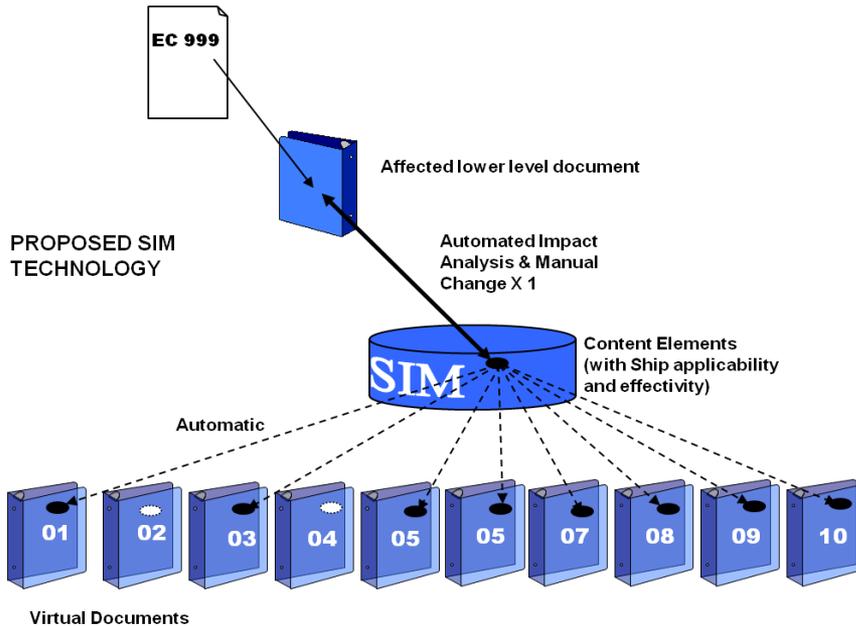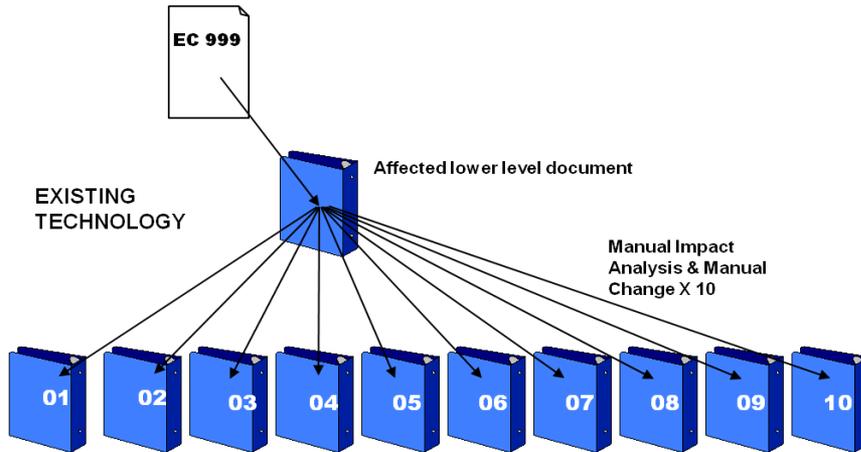- Documentation must match reality
  - Correct
  - Applicable
  - Effective
  - Available
  - Usable
- Contradictory demands on publisher
  - Fast
  - Quality
  - Low cost

Revolutionary impact of structured documentation

Annotation

- Annotation functions are the key to converting authors implicit contextual knowledge to codified explicit knowledge
- Links are 2-way
  - Document authors' IP for future reference
  - Change management