

# Issues on DIV Knowledge-Sharing

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# DIV creates knowledge...

- The end-product of all DIV work is knowledge.
- We present that knowledge to our clients in various forms:
  - reports
  - advice
  - data-extracts
  - inspection procedures
  - techniques and technologies
- Our clients come to us because of the *experience* and *expertise* that underlies the information we provide.



# ...so how do we store and share it?

- A simple question, from Noel Martin:
  - *“How would you store thirty years of experience in a database, in a form you could share with others?”*
- It’s a simple question to ask...
  - ...but not so simple to answer!
- So we think it’s worthwhile to ask how knowledge-management and knowledge-sharing are handled in DIV - and what we could *all* do to improve it.



# Knowledge-sharing is mandated in ORG

- The need for knowledge-management and knowledge-sharing is formally recognised in ORG:
  - CEO Ian Hammell spoke recently about the need for “the boundaryless sharing of ideas”
  - understanding of knowledge-management is a key objective of ORG’s Leadership Program
  - knowledge-sharing is a measurable ‘performance indicator’ for Balanced Scorecard
  - the DIV Charter lists several ‘emerging capabilities’ which depend on knowledge-sharing
    - damage prediction, analysis of risk and reliability, retirement-for-cause, assessment of widespread damage



# Why is knowledge-management important?

- Knowledge-management has been described as “a costly, political, ceaseless process”...
- ...but the cost of poor knowledge-management is higher still:
  - *“How much does it cost an organisation to forget what key employees know, to be unable to answer customer questions quickly or at all, or to make poor decisions based on faulty knowledge?”*
    - Tom Davenport, director, Information Management Program, University of Texas at Austin
- For DIV, best-practice knowledge-management isn't a luxury:
  - trying to work without it is a luxury we can't afford!



# What do we mean by 'knowledge', anyway?

- Knowledge is a combination of three types of information:
  - *data* - objective, usually quantitative
    - provides *information content*
  - *metadata* - 'information about information'
    - identifies *information context*
  - *connection* - subjective, usually qualitative
    - derived from experience
    - describes perceived relationships between data-items
    - indicates *information meaning*
- Objective data are easy to store in databases...  
...but are meaningless without metadata and connections!



# Current knowledge-sharing in DIV

- Current examples of DIV knowledge-sharing include:
  - *Formal reports* - results of research
    - incomplete summaries; no source-data; no means of search
  - *DIV intranet* - links to work in progress
    - few Tasks linked in; no search-mechanisms
  - *DIV Management System* - extends Quality System
    - Quality System used by only small number of Tasks; Management System only just released
  - *Inter-Task data-transfers* - transfers of source-data
    - largely ad-hoc; rarely planned in advance; rarely in self-describing data-structures
- Most of this is *data*-sharing, not *knowledge*-sharing - DIV knowledge-maintenance relies mostly on human memory!



# A DIV horror-story...

- DIV support for the KV Life Extension program:
  - at least two man-years expended on:
    - trying to identify ‘missing’ information
    - searching ‘inherited’ filing-cabinets
    - building a catalogue of recovered paper-documents
      - *but still no real search-facilities available!*
  - Primary Test needed 30yr-old test-data:
    - data eventually recovered from fragile tape-reels
    - recorded data-structures could only be guessed...
  - etcetera, etcetera...
- *All of this heart-ache and head-ache could have been avoided if proper long-term knowledge-management had been used!*



# ...and worse to come?

- Real problems for KV knowledge-management
  - but no technology is needed to read paper documents!
- Without action, future problems could be even worse:
  - proliferation of data formats
    - ‘the forgotten generation’ (National Library)
    - rapid obsolescence of software, hardware, system architectures
  - test-data kept on personal machines, not in Lab books
    - risk of data loss on system failure or system change
  - increased staff turnover
  - loss of ‘corporate knowledge’ when staff resign or retire
    - we can’t go backward in time to replace it!
- *DIV needs reliable knowledge-management tools now!*



# Some benefits of systematic knowledge-management

- “Creating an enterprise-wide knowledge management system is not a simple task. However, the benefits of a well-designed system are immense:
  - *awareness*
    - everyone knows where to go to find the organisation’s knowledge, saving people time and effort
  - *accessibility*
    - all individuals can use the organisation’s combined knowledge and expertise in the context of their own roles
  - *availability*
    - knowledge is usable wherever it is needed, enabling increased responsiveness to customers, partners and co-workers
  - *timeliness*
    - knowledge is available whenever it is needed, eliminating distribution of information ‘just in case’ people are interested”



# What knowledge-management provides

- Systematic knowledge-management and knowledge-sharing would provide:
  - secure, reliable access to raw and expanded data
  - consistent interfaces to DIV's 'knowledge silos'
  - access to data, metadata and connections
    - provides content, context, interpretation and meaning
  - consistent search and cross-reference across all of DIV's shared knowledge
  - audit-trails and activity-histories for work carried out in DIV
  - identification of and access to people with experience and expertise

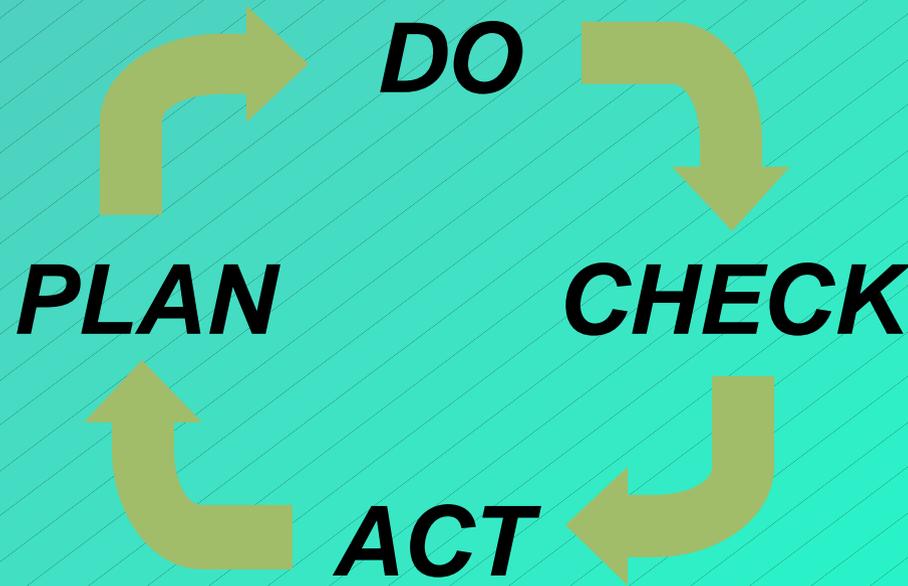


# Knowledge-management isn't 'just another database'

- Current knowledge-management systems depend in part on database technology to provide:
  - *storage* - data, metadata, connections
  - *search and cross-reference*
  - *access-control*
  - *usage and performance metrics*
- But knowledge-management depends just as much on:
  - *leadership* - a commitment to organisational quality
  - *change-management* - creating a 'learning organisation'
  - *culture* - creating a habit of sharing knowledge and exploring its potential for re-use



# Knowledge-management isn't a project



- Like TQM and Balanced Scorecard, knowledge-management isn't a short-term project
  - it's a cyclical process of review and improvement
  - it's a process that never ends!



# Some steps towards knowledge-management

- One company's 'Seven Steps to Implementing Knowledge Management' are as follows:

1. Identify the business problem
2. Prepare for change
3. Create the Knowledge Management Team
4. Perform knowledge audit and analysis
5. Define key features of the system
6. Implement the building blocks
7. Link knowledge to people

(Dataware Technologies, Inc.)

- For DIV purposes, the sequence might change, but the list would probably remain the same.



# Why it's important to identify requirements

- The general experience is that trying to implement a knowledge-management system in one go is a bad idea:
  - it's usually too expensive
  - it often doesn't work, because requirements aren't clear
  - it's usually too much of a 'culture shock'
- Implementation should always be iterative
  - for DIV / ORG, should probably be over several years
- Clearly-defined requirements support iteration towards best-practice knowledge-management
  - requirements provide a means to measure progress
  - prioritised requirements maximise leverage



# Some requirements relevant to knowledge-sharing

- Requirements should define data to be recorded for:
  - *work-tracking* and *workflows* (i.e. quality-system)
  - *tests* and *processes* (i.e. what was done)
  - *test-results* and *test-data* (i.e. what was found)
  - *information-items*
    - documents, images, test-specimens, objects, data-extracts
  - *threads of interest* (i.e. results of subsequent analysis)
    - platforms, components, materials, defect-types, widespread damage, repeated problems, processes
  - *descriptive articles*
    - theory guidelines, local best practice
  - *connections* and *comments* (i.e. perceived meaning)



# A question of lifetime

- The current draft of the DIV Management System states that test-record life is ‘five to ten years after Task completion’.
- This may be much too short - lifetime should be greater of:
  - five to ten years, *or*
  - platform lifetime, *or*
  - material lifetime, *etcetera*
- Effective lifetime could be *fifty or more years*, which exceeds:
  - Task lifetime (one to three years)
  - software or hardware lifetime (three to five years)
  - typical government policy lifetime (ten to twenty years)
  - typical working lifetime (twenty to forty years)



# Some questions about knowledge-sharing

- In planning for knowledge-sharing, it's useful to ask:
  - what knowledge do we expect to share?
    - *knowledge components*: data, metadata, connections
  - with whom do we expect to share this knowledge?
    - *others in the present*: clients, other Tasks, ORG, government, other alliances, academics, industry
    - *others in the future*: including ourselves!
  - what other uses might others find for our knowledge?
    - *example*: investigators requesting photos from KV tear-down of paintwork in inner structure
  - how could we make it easier to re-use our knowledge?
    - *examples*: additional metadata fields, overview notes, links to material on current theory or practice



# Features of knowledge-management systems

- Whatever system we develop and use, it will need to be:
  - open and distributed
    - provide a consistent interface to unify existing and future ‘knowledge silos’
  - customisable
    - provide consistent interface, but support the different requirements of each Task
  - measurable
    - provide tools to allow managers to measure and verify usage, locate performance bottlenecks, suggest improvements to organisational knowledge-transfer processes
  - secure
    - provide open access with ‘need to know / need to use’ control



# 'Anything goes' - a spectrum of knowledge-systems

- A knowledge-management / knowledge-sharing system can be implemented in *any* way, as long as it's systematic:
  - *paper-based system*
    - paper forms, reports, lab-books, printouts
    - typical legacy system
    - easy to store, but *very* difficult to search!
  - *computer-based system*
    - on-screen data-entry, search, review
    - may permit direct data-exchange with Task clients / others
    - easy search / cross-reference, more difficult to store / maintain
- The system-architecture should assume and support iterative improvement of the system.



# Some security issues for knowledge-sharing

- Basic requirements:
  - ‘*need to know*’: access to information
  - ‘*need to use*’: access to function
- Multiple security categories:
  - *strategic* - responsible to government
  - *judicial* - responsible to court
  - *commercial* - responsible to commercial organisation
  - *personal* - responsible to individual
- Combinations of security-categories occur often
- Constraints are volatile over time
  - constraints need regular review



# Knowledge-management in the ENG Task

- Knowledge-management issues are more obvious and severe in ENG than in some other Tasks:
  - hundreds of discrete jobs handled each year
    - turn-round time may be in days, not a Task's one to three years!
  - many jobs exchange data with other DIV Tasks
    - ENG jobs often lead to extended DIV Tasks
  - issues often recur over decades
    - *examples*: CJ engine, HST structure, materials issues
  - phone or email enquiries may lead to major new work
    - *examples*: FSP support cracks, feedline contamination
- The needs are more urgent, but most ENG knowledge-management requirements are the same as for other Tasks.



# What the ENG Task has done and is doing

- Over the past year in the ENG Task:
  - basing KM study on KV Primary Test experience
    - *Andrew Burdock's model*: for each item, “tell me about yourself, tell me what you're associated with”
  - knowledge-management team
  - identifying requirements
    - every requirement has a testable ‘fit criterion’
    - identifying Task-local versus DIV-global requirements
  - integrating data/knowledge mgmt with quality-system
  - some preliminary implementation
- Current requirements, documents and concept-model are on the ENG section of the DIV intranet



# Knowledge-management and quality-management

- We believe that knowledge-management works best as an extension of the quality-system:
  - quality-system provides *purpose*
  - work-details and practices may change over time, but the basic nature of the work does not change
  - policies, procedures, work-instructions define data and metadata to be recorded during work
  - quality-system provides standards and mechanisms for knowledge-sharing and knowledge maintenance
- For knowledge-sharing, knowledge acquired in ENG work needs to be linked with the DIV system - which doesn't exist!



# Customer-enquiries - a danger-area for ORG?

- During our work, we've identified some serious legal and other risks arising from email and phone enquiries:
  - some government and other clients are treating initial / unreviewed enquiry-responses as *formal* advice
    - disclaimers on emails do help, but may be ignored
  - enquiry information may need to be shared with others
    - others in the Task, or elsewhere in DIV / ORG
  - enquiry significance may become clear only later
    - some issues take years to mature
  - all information may be lost if is not immediately recorded
    - need consistent ORG-wide procedure for this
- We're seeing this issue more often - other Tasks will see it too.



# Some current moves towards shared knowledge

- At present, systematic knowledge-management is supported only sparsely at DIV and higher levels, though there are some new developments:
  - KV Project Database
    - an example of a database that provides some support for user-defined connections between data-items
  - Test-Data Repository project
    - experimental use of 'self-describing' data-structures
    - system architecture not well suited for inter-Task data exchange
  - the ORG document-management system
    - system to be available ORG-wide, but details not yet known
    - handles documents and workflows, but not other data-items which will be referenced in DIV knowledge-management



# The need for shared standards

- Serious legacy problem: frequent use of incompletely-described, often arbitrary data-structures.
- Reliable knowledge-exchange depends on shared standards:
  - choice of standards should be determined by who we need to share with
  - international standards for ‘self-describing’ structures
    - NCSA, SGML, XML, XSL, XLL, etcetera
    - KV Project database outputs WDDX-format XML data-structures
    - XML data-structures beginning to be required by Defence
  - DIV could help define new industry standards
    - Defect Codification Scheme (*extends existing industry scheme*)
    - Process Codification Scheme (*standardised data-sets*)



# Knowledge-management - Tasks, DIV and above

- No Task can or should attempt to do knowledge-management on its own - responsibilities should probably be split as:
  - *Task*
    - define own requirements
    - customise shared system to suit local requirements
  - *DIV*
    - define DIV-wide requirements and standards
    - allocate 'Knowledge Officer' role as independent Task
    - explore possibilities for internal / external knowledge-sharing
  - *ORG*
    - define organisation-wide standards, support Knowledge Officers
    - support knowledge-management as organisational culture - it's not a short-term project!



# Conclusion - or call to action?

- So how could we store thirty years of experience in a database, in a way that others could use?
- *Answer:*
  - by making it easy to do so, for everyone, every day.
- *Answer:*
  - by providing secure database support not just for data, but also for metadata and connections;
  - by providing facilities for organisation-wide cross-reference and search.
- *Answer:*
  - by acknowledging our responsibility to the future as well as to the present.

