DCODE

Decision Making Constructs in a Distributed Environment

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Report Documentation Page

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Definition of Key Terms

- **SHARED** information (**SI**):
  - Information items that are held by all participants in a group decision making environment.
    - CNN reports, products from common search engines, etc.
- **UNIQUE** information (**UI**):
  - Information items that are held by one (or some, but not all) member(s) of the group.
    - Personal information sources, previous experiences, special database access, etc.

Problem Areas

- Literature Review Indicates:
  - People are not very good at sharing UI.
    - Discussion time is spent mostly on SI.
  - When UI is shared with the group, it often has little impact on final decision selection.
    - Weighting is placed on SI

Classic Study (Stasser & Titus, 1985):

Who Should We Admit to Our College?

Condition 1: Everyone has all the information (all SI, no UI)

Condition 2: all info is on table, but distributed across people (some SI, some UI)

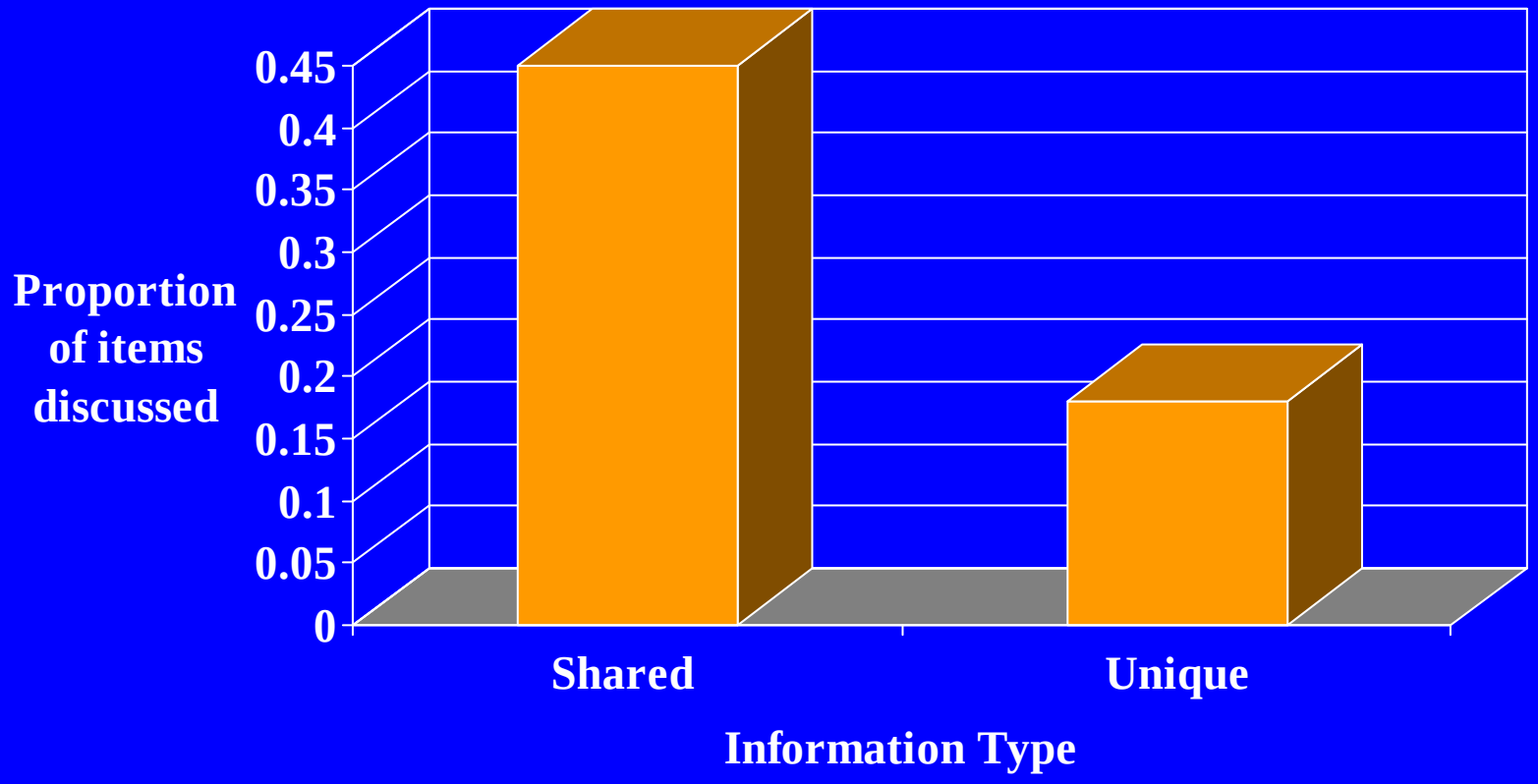
Probability of "correct" decision.

.83

.23

Discussion of SI vs. UI

SI discussion "crowds out" time available for UI



Very Consistent Finding

DCODE Basic Assumption

- In asynchronous collaboration, social factors (prestige, personality, etc.) still play a role

BUT….

- the primary obstacle to effective information exchange is the **cognitive burden** placed upon both the sender and recipient of the information.

Cognitive Burden (sender perspective):

- Is this item **really unique**, and not available to the other participants?
- Is it **important enough** to send?
- Is this the **best** example to send?
- Should I send it **now or await** for further input/confirmation?
- Send it to **all participants**, or just selected subgroup?

Cognitive Burden (receiver perspective):

- I have arriving information items (which I did not develop/find) related to my decision task. I need to determine:
  - **Which particular decision aspect do these items impact?**
    - Cost, Risk, Duration, etc?
  - **What is it's potential influence?**
    - Does it have a positive or negative influence on cost, risk, etc.?
  - **Is this timely information from a credible source?**
    - How recent is this information? What is the source?
  - **Does the information impact the credibility of information items that I am currently using?**
    - If so, what is the overall "domino effect" of this?

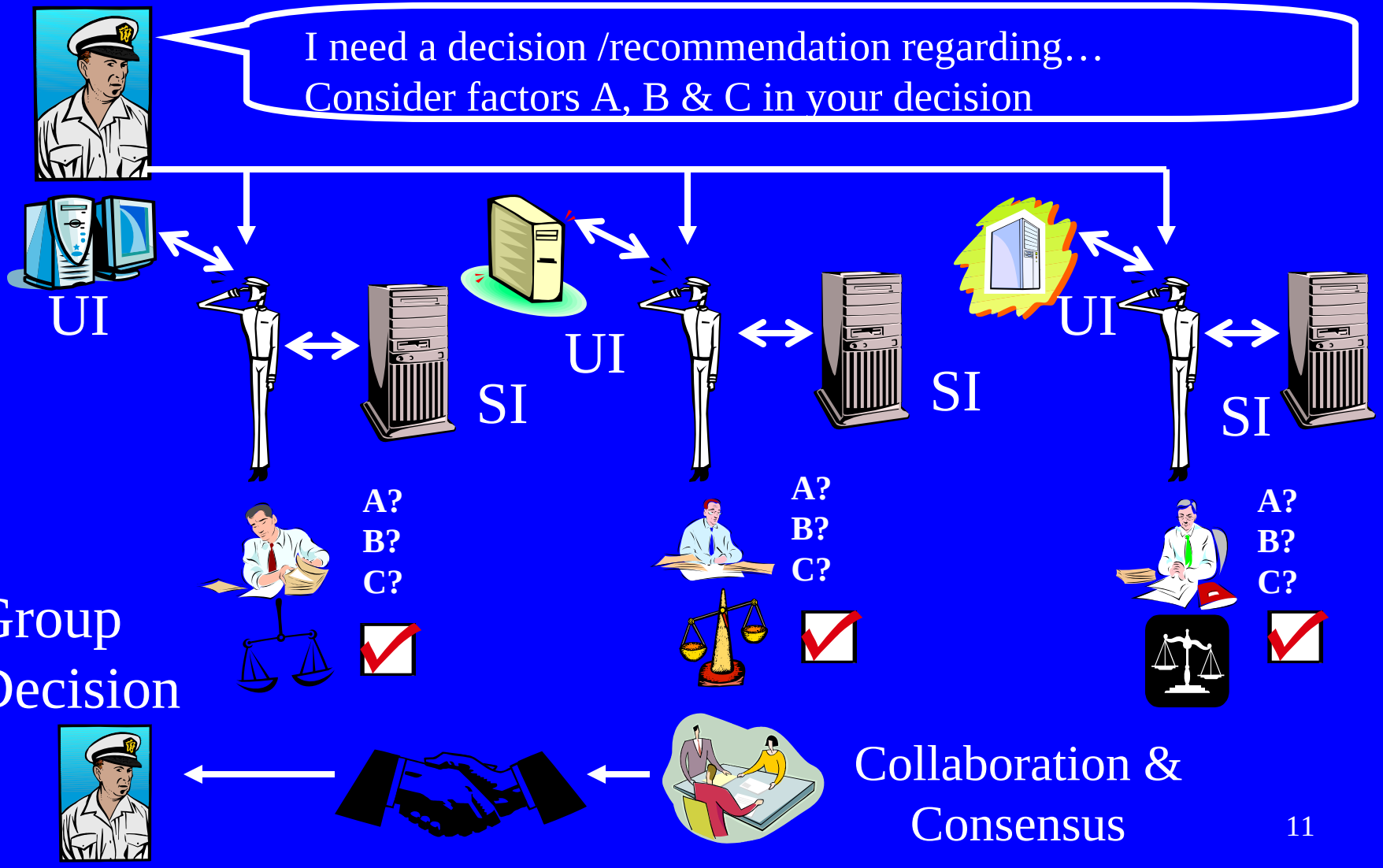
DCODE Objectives:

- Overall:
  - Enhance the ability of asynchronously distributed group decision makers to share their UI…
  - Improve overall group decision quality through the effective integration/weighting of shared UI items…
  - without imposing an excessive cognitive burden
- This Year:
  - Expand conceptual model designed to address these issues
  - Experimental verification of selected model concepts
  - Interface with EWALL technologies

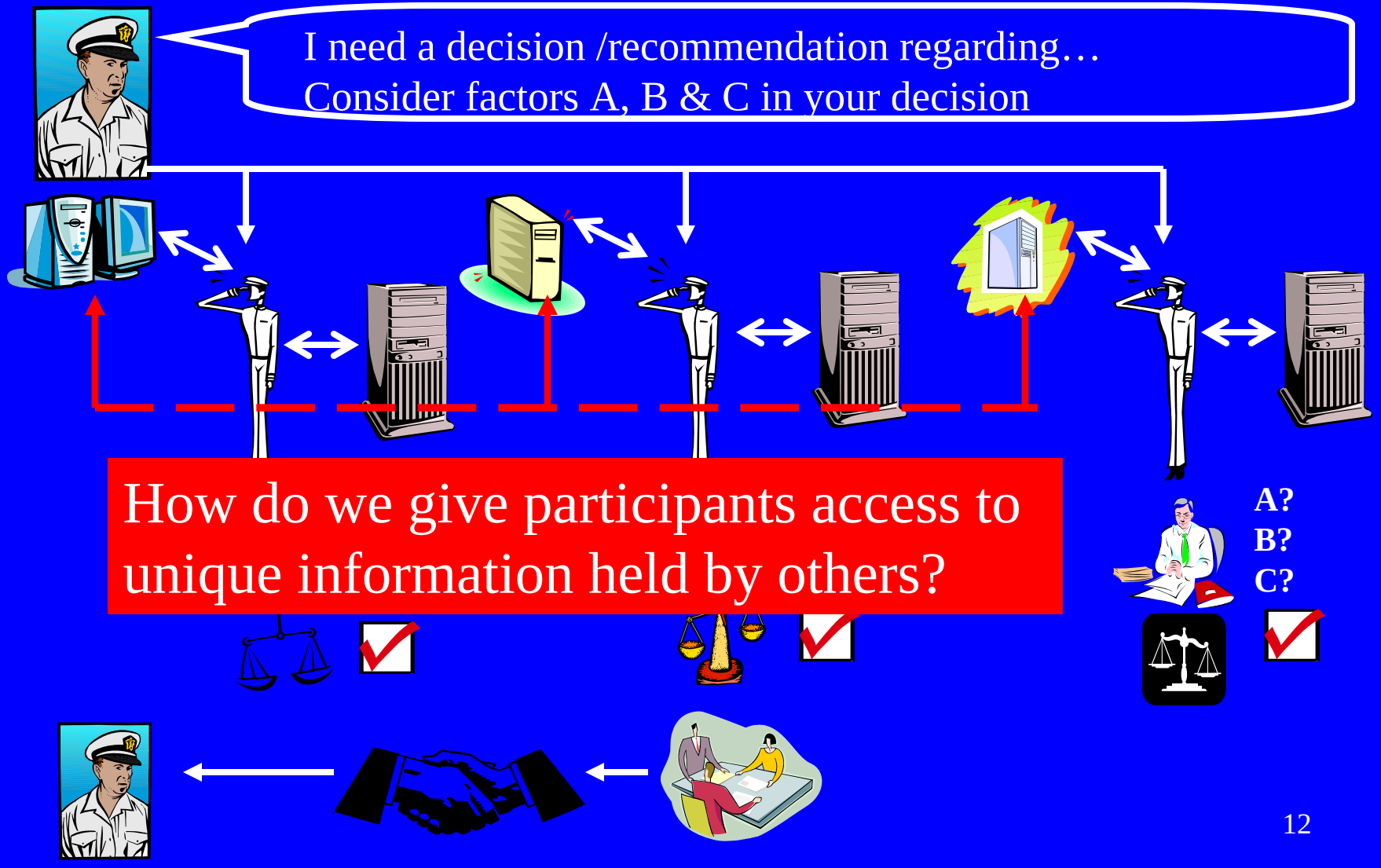
Expected Final Products

- A collaborative software suite that includes
  - Simplified **Knowledge Elicitation technologies** for adding (tagging) individual information evaluation parameters.
  - **Group database browsers** for finding/sharing UI
  - **Ewall-type** interface for using this tagged information to:
    - Assist a team member make a decision/recommendation
    - Assist the group in reaching final overall consensus

Decision Process Flow Model



DCODE Research Issues



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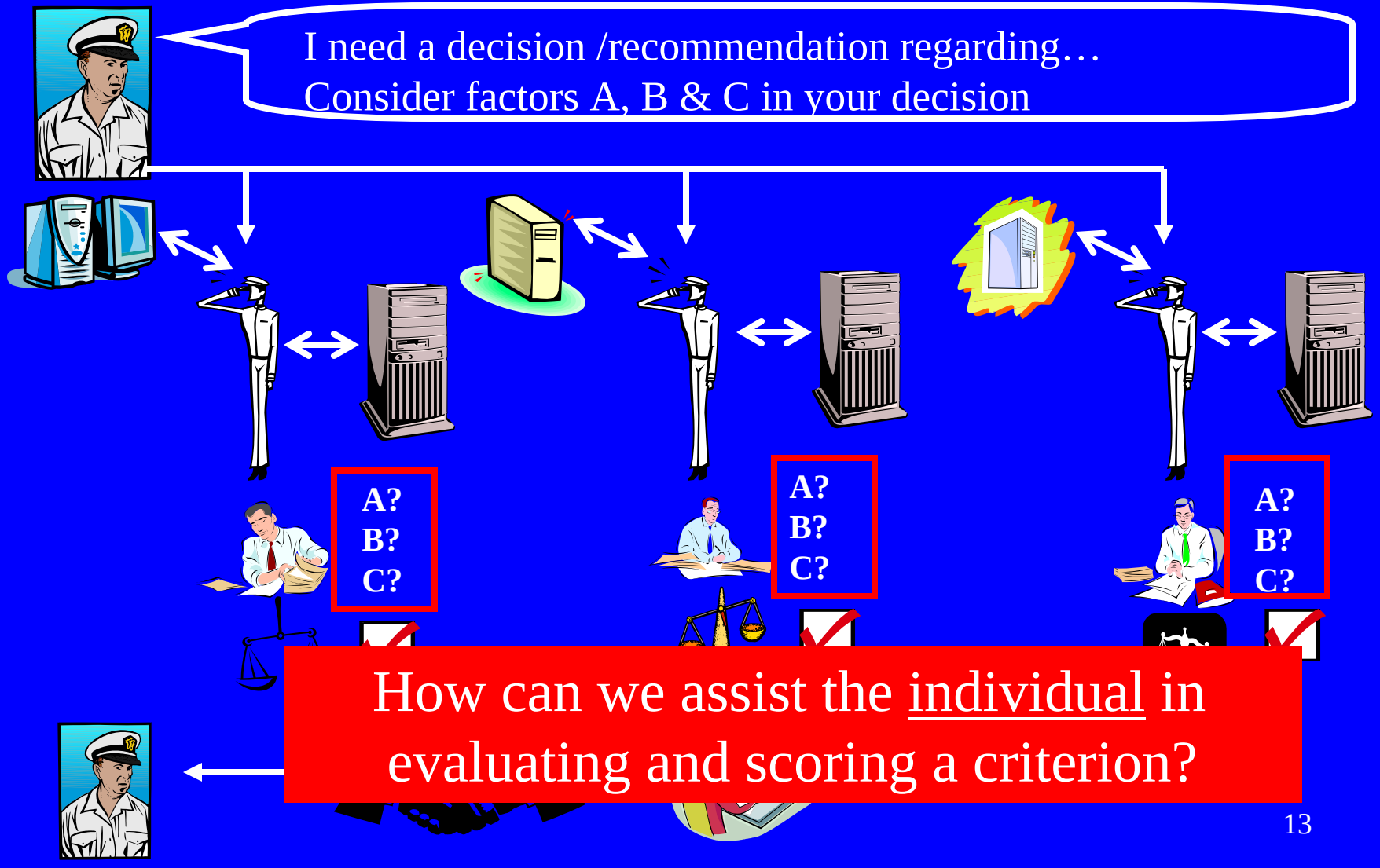

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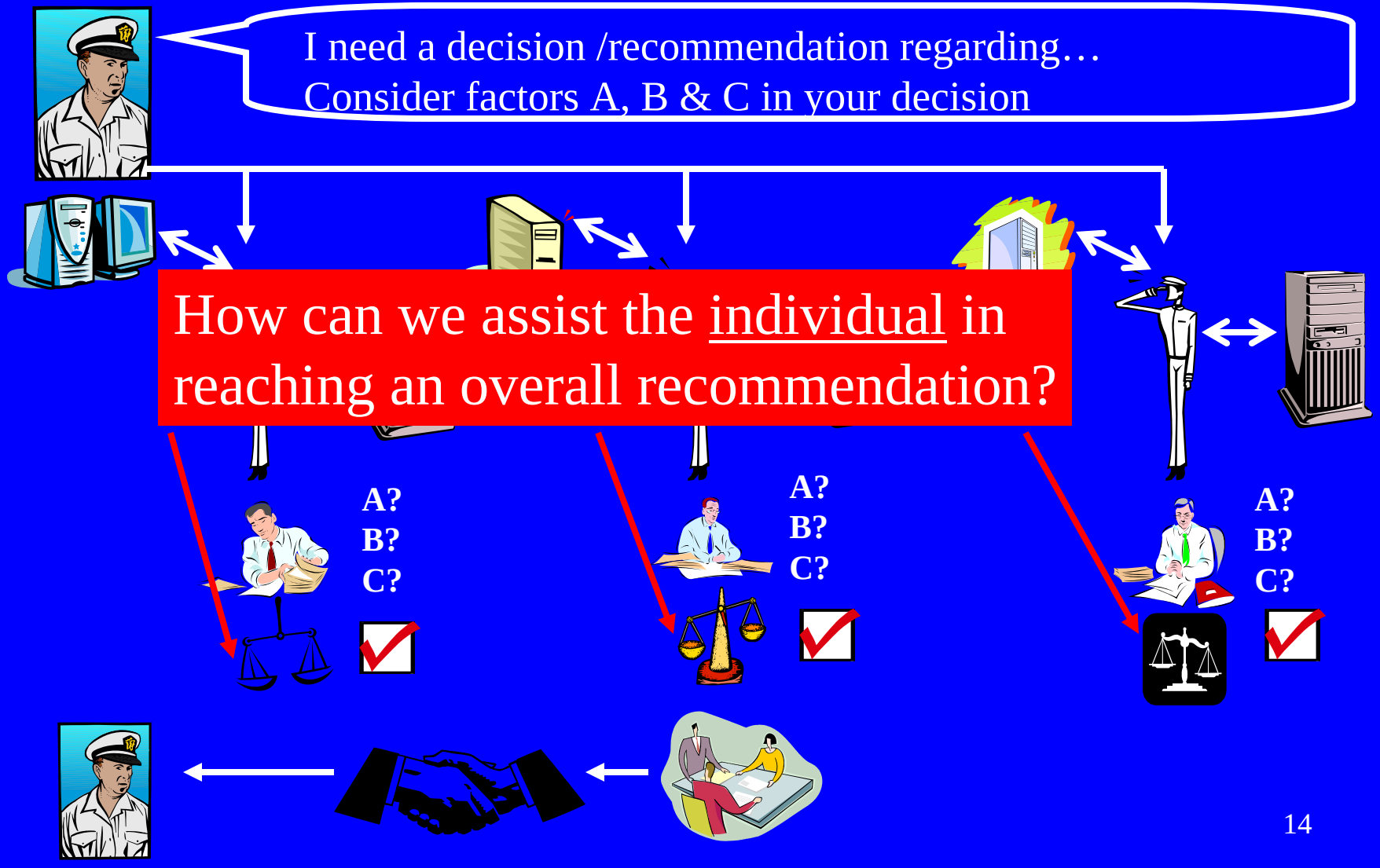

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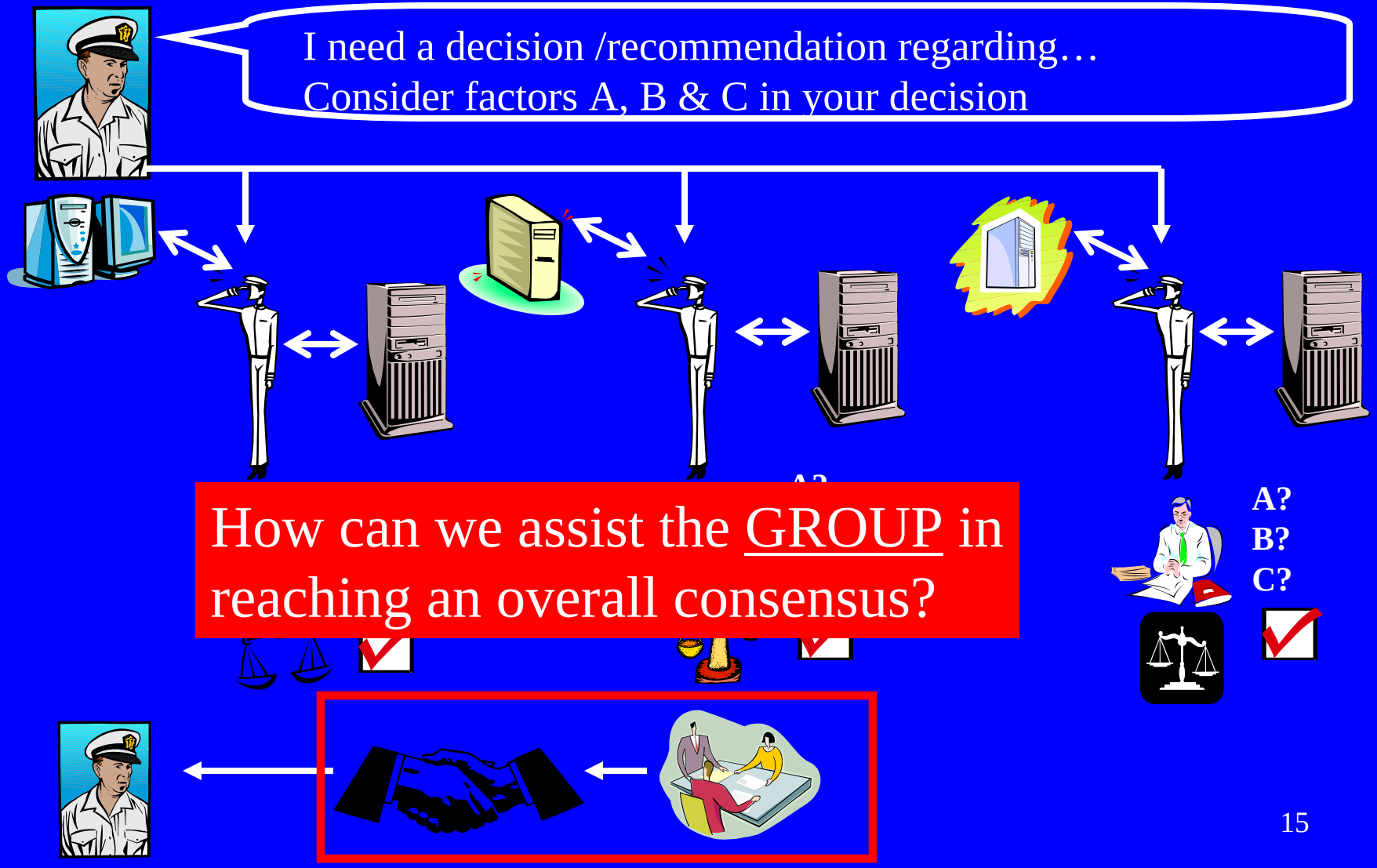


Research Questions

How can we assist the individual in evaluating and scoring a criterion?

- The analyst sorts and structures incoming information items (belongs to A or B or C)
- The analyst assigns his subjective evaluation to specific information content (a knowledge elicitation, "tagging" process). Parameters might include:
  - Importance
  - Information impact (positive or negative)
  - source credibility
  - timeliness, etc.

EWALL News Capture

Fading time line (soon by priority/relevance)

Category

Expansion

Item has:
Source
URL
Time date
Title
Summary
Body

But It needs:

which category...?

Importance (hi-lo)

Impact (Pos/Neg)

Credibility (good/bad)

Timeliness (new/old)

Each item has two types of information

ID/Tracking and Content parameters (no real disagreements)

- Source
- URL
- Time date
- Title
- Summary
- Body

Subjective, decision relevant information analysis/evaluation…. (disagreements expected)

- Relates to...?
- Importance (hi-lo)
- Timeliness
- Influence (Pos/Neg)
- Credibility (good/bad)

Each information item (“card”)

ID

Analysis

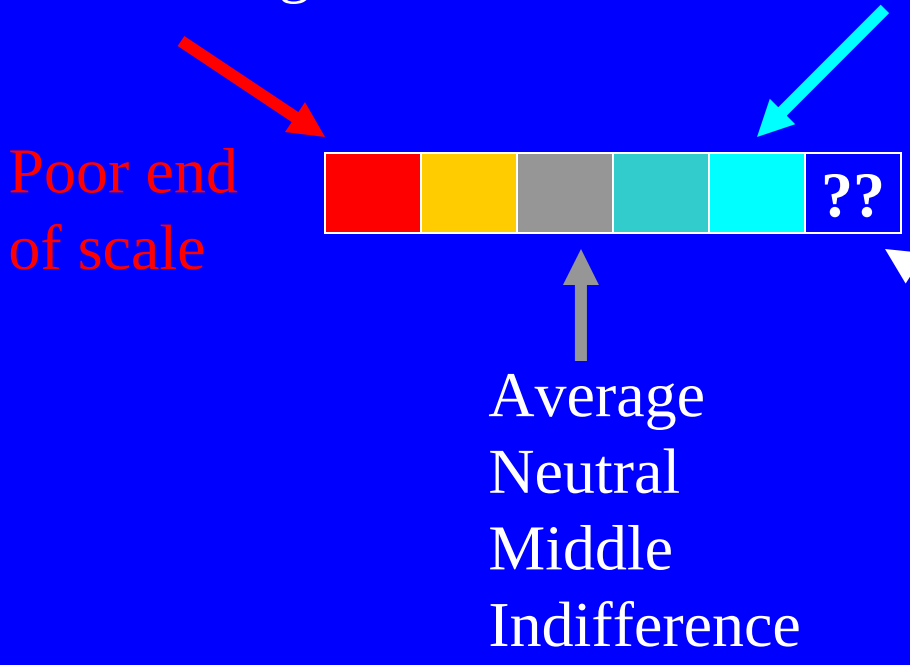
CNN	World	12:25 PM	PRAGUE, CZECH REPUBLIC: Protesters call for NATO's end	1:44 PM
Category: A/B/C/ Cost/Risk/Duration				
Importance:				
Impact				
Credibility				

Proposed knowledge elicitation schema for analysis of information items

Worst
Lowest
Least
Most Negative

Best
Highest
Most
Most Positive

Goal: Minimum Cognitive Burden



The knowledge elicitation "tagging" process

"The Rangoon Times reports unconfirmed rumors that the Minister of the Interior has resigned today after the tragic collapse of the newly constructed bridge at…"

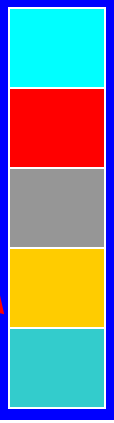
Criteria:	Political Stability					
Importance:					X	??
Impact:	X					??
Credibility:			X			??
Certainty:		X				??
Timeliness:				X		??

Save

Saved Information item # PS3 (can also be viewed as EWALL "card")

ID

Political Stability item #PS3



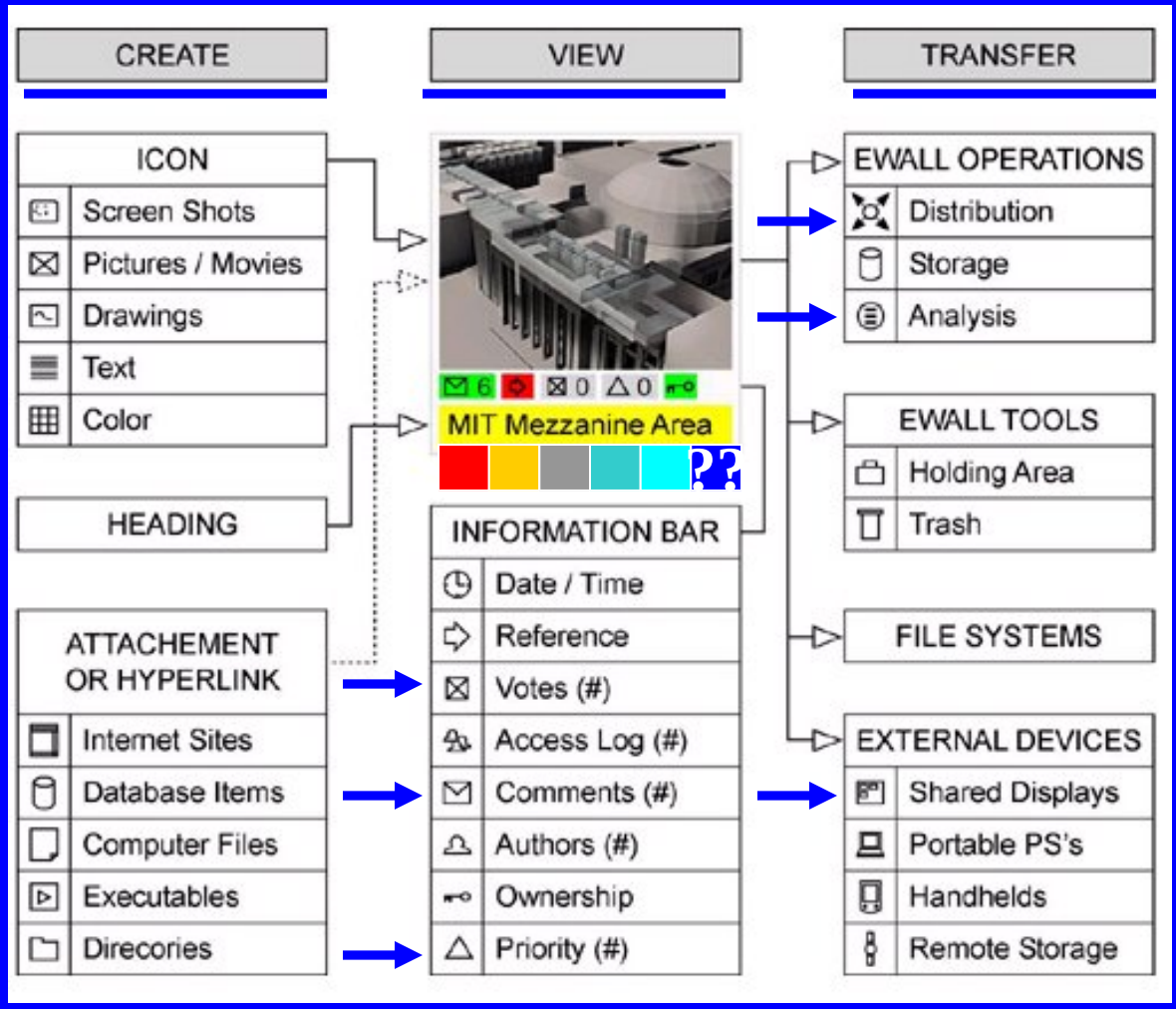
Impor
Impct
Cred
Cert
Time

"The Rangoon Times reports unconfirmed rumors that the Minister of the Interior has resigned today after the tragic collapse of the newly constructed bridge at…"

Information Analysis

Short Descriptor

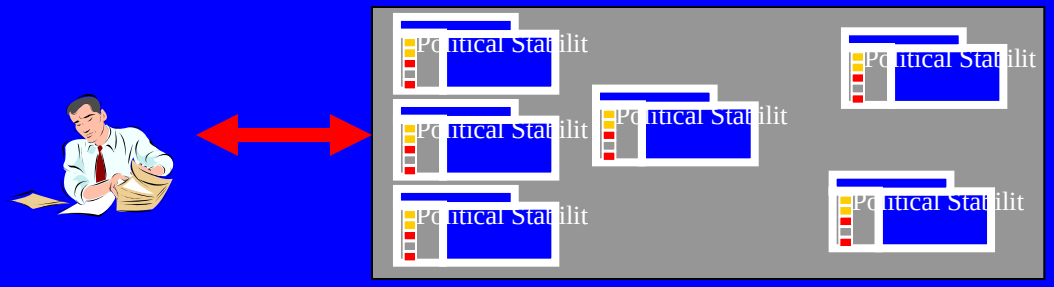
EWALL Structure*



*Paul Keel, MIT

How can we assist the individual in evaluating and scoring a criterion?

Analyst uses interface to EWALL technology to evaluate each criterion

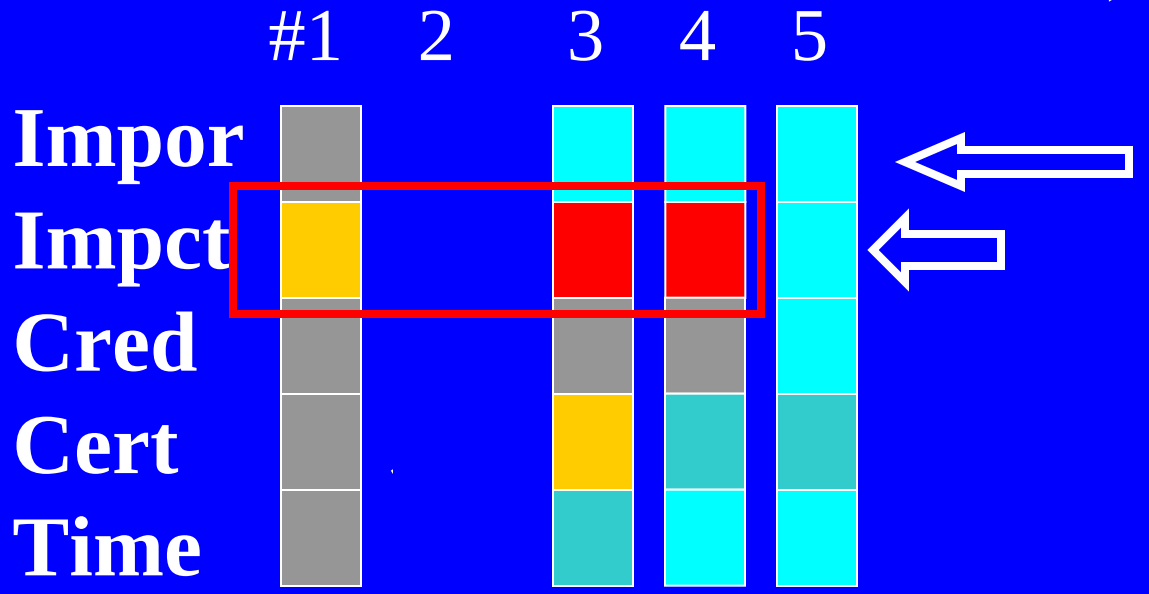


Political Stability Items

The EWALL algorithms uses the tagged information to sort, rank, link (whatever the user specifies) the items into a meaningful framework for analysis and final criterion evaluation/scoring

Analyst uses EWALL technology to evaluate criterion

Political Stability Summary
(5 items for each of five criteria)



Political Stability Rating:

How can we assist the individual in reaching an overall recommendation?

Same as before except now the items/cards represent his evaluation score assigned to each criterion

Scoring of four selection criteria

Political Stability

Cost (use of assets)

Duration of Ops

Local Security

Individual Recommendation: NO

How do we give participants access to uniquely held information?

My PS Items

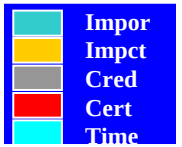
Political Stability item xxx

" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Political Stability item xxx

" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Political Stability item xxx



" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Political Stability item xxx

" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Other analyst's PS items

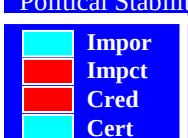
Political Stability item xxx

"The Rangoon Times reports unconfirmed rumors that the Minister of the Interior has resigned today after the tragic collapse of the newly constructed bridge at…"

Political Stability item xxx

" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Political Stability item xxx



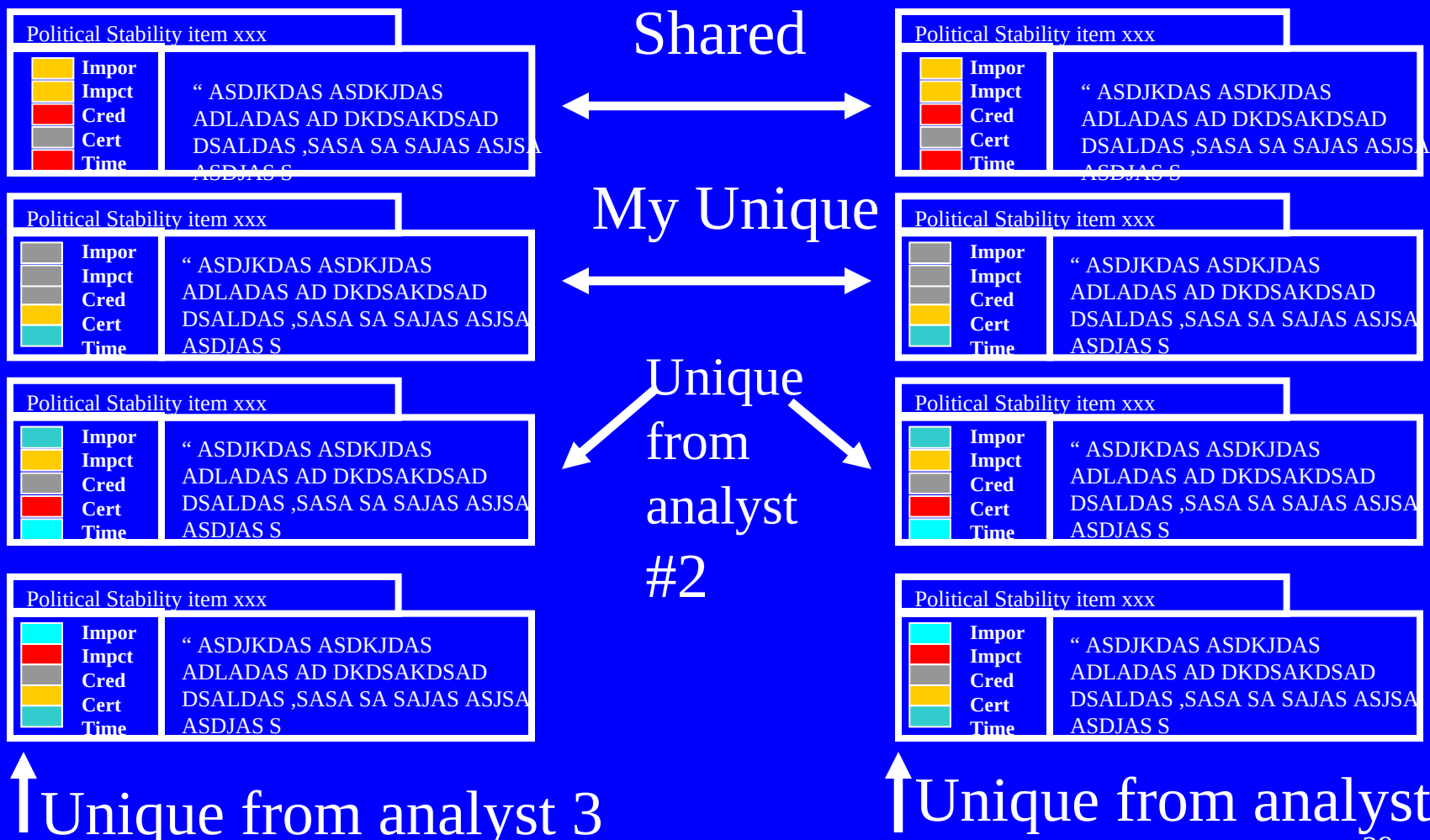
" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Political Stability item xxx

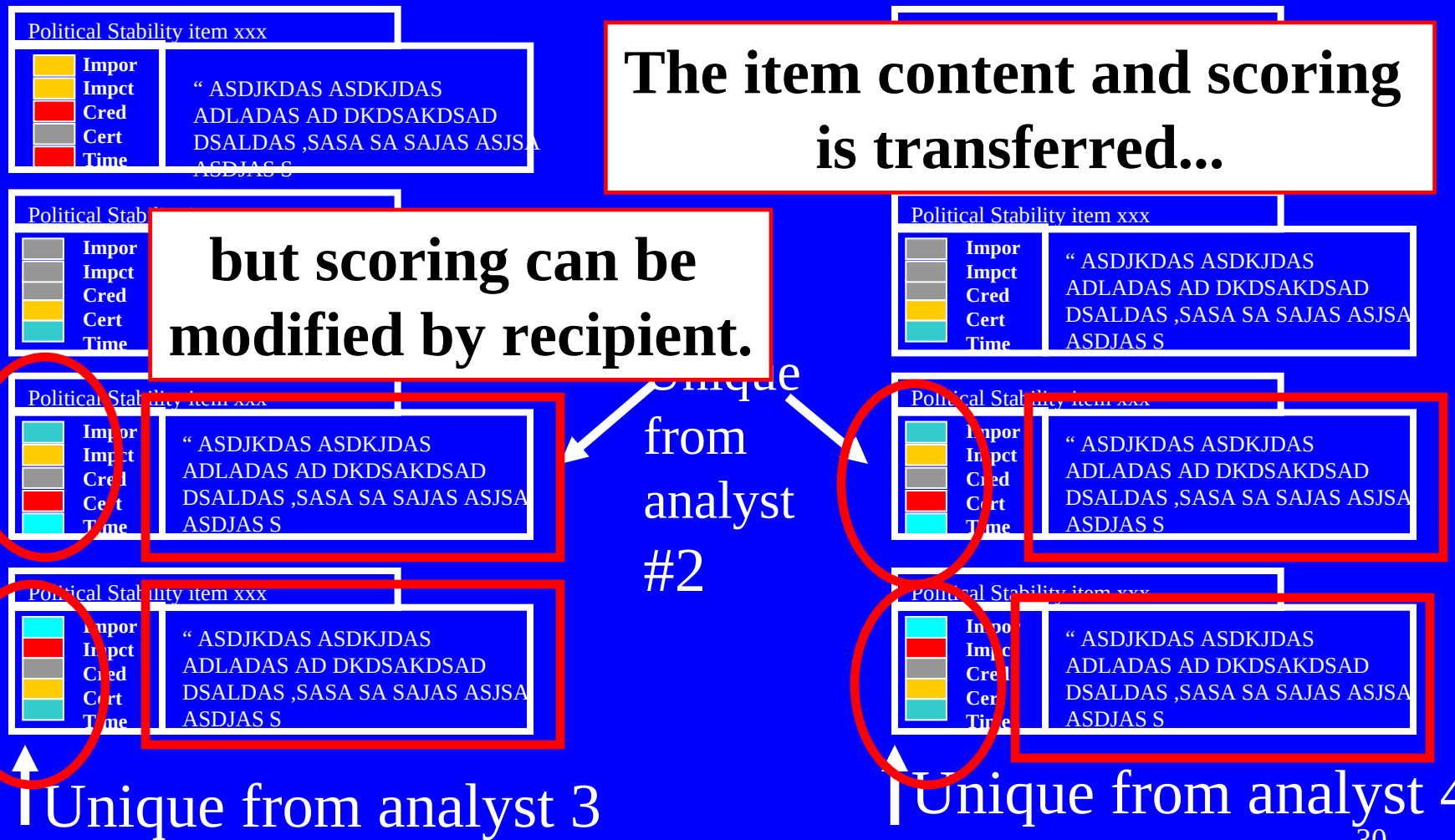
" ASDJKDAS ASDKJDAS ADLADAS AD DKDSAKDSAD DSALDAS ,SASA SA SAJAS ASJSA ASDJAS S

Send me non-duplicative items rated Important

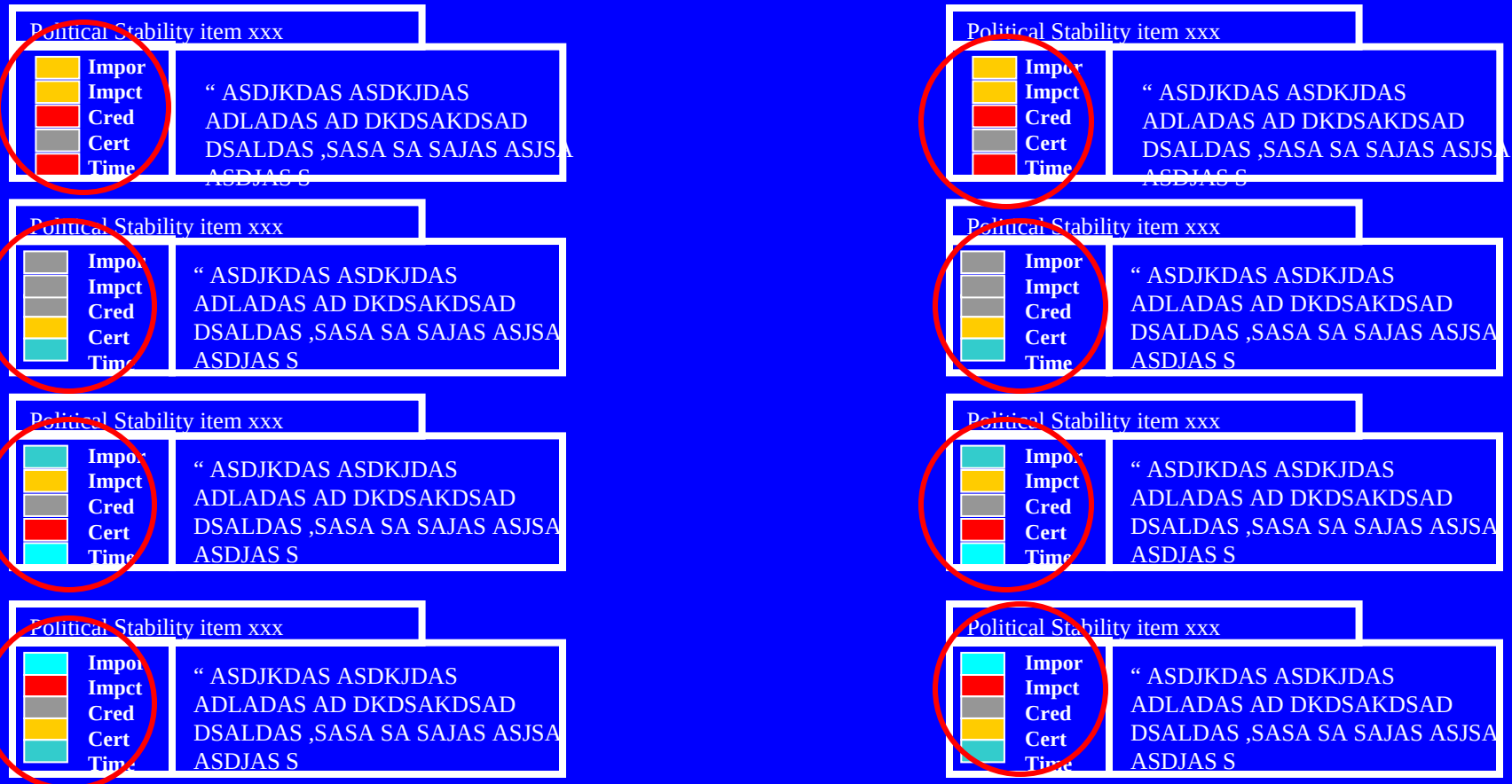
My Full Array of Information Items



With Transfer of Unique Items:



ALL the Analysts have the same array of PS items



THIS is what differs

At this point...

- There has been **NO** collaboration between participants
  - exchange of UI was assumed to be an automated database search process on tagged information items
- Tagging and EWALL technology have been used to make **individual** judgements/decisions

(When in an asynchronous mode, a large amount of the information is processed/analyzed independently)

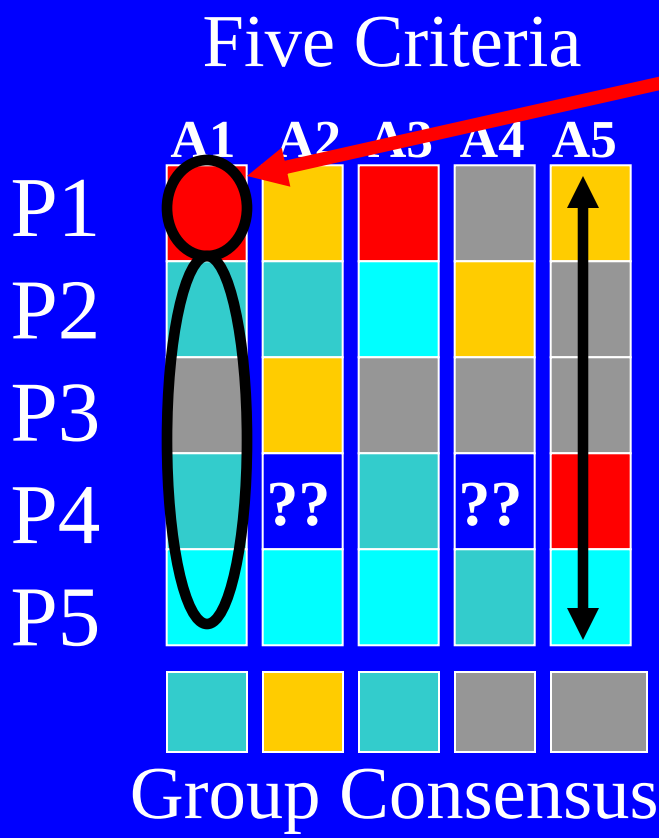
- But, the final **GROUP** recommendation requires…
  - collaboration
  - consensus building

Collaboration is via shared/networked EWALL display

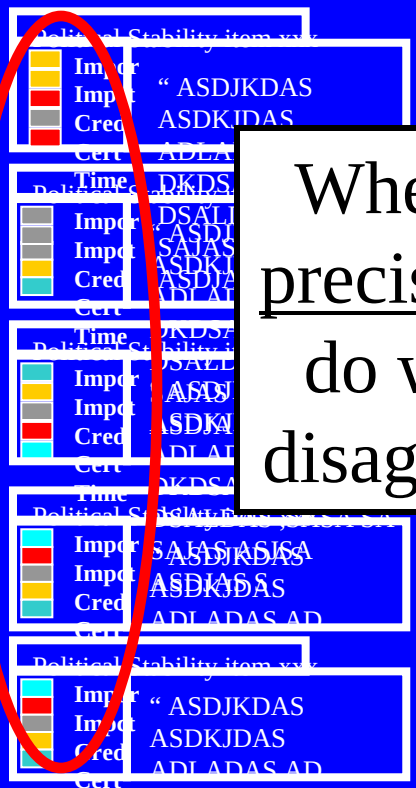
- If the UI exchange process has been successful, all the participants are using the **same information items**
- Differences in scoring is on the individual **interpretation** of the information items
- Individual interpretation is reflected in the **tags assigned** by each participant and
  - can serve as a focus for group discussion
  - forms a framework for consensus building

Reaching Group Consensus on Criterion Scores

Five Decision Criteria ("A"), Five Participants ("P")



P1 scores on criterion A1



Where, precisely, do we disagree?

How can we assist the Group in reaching an overall consensus/recommendation?

EWALL items now become the group criteria scores

Group scoring of decision criteria

A1: Political Stability

A2: Cost (use of assets)

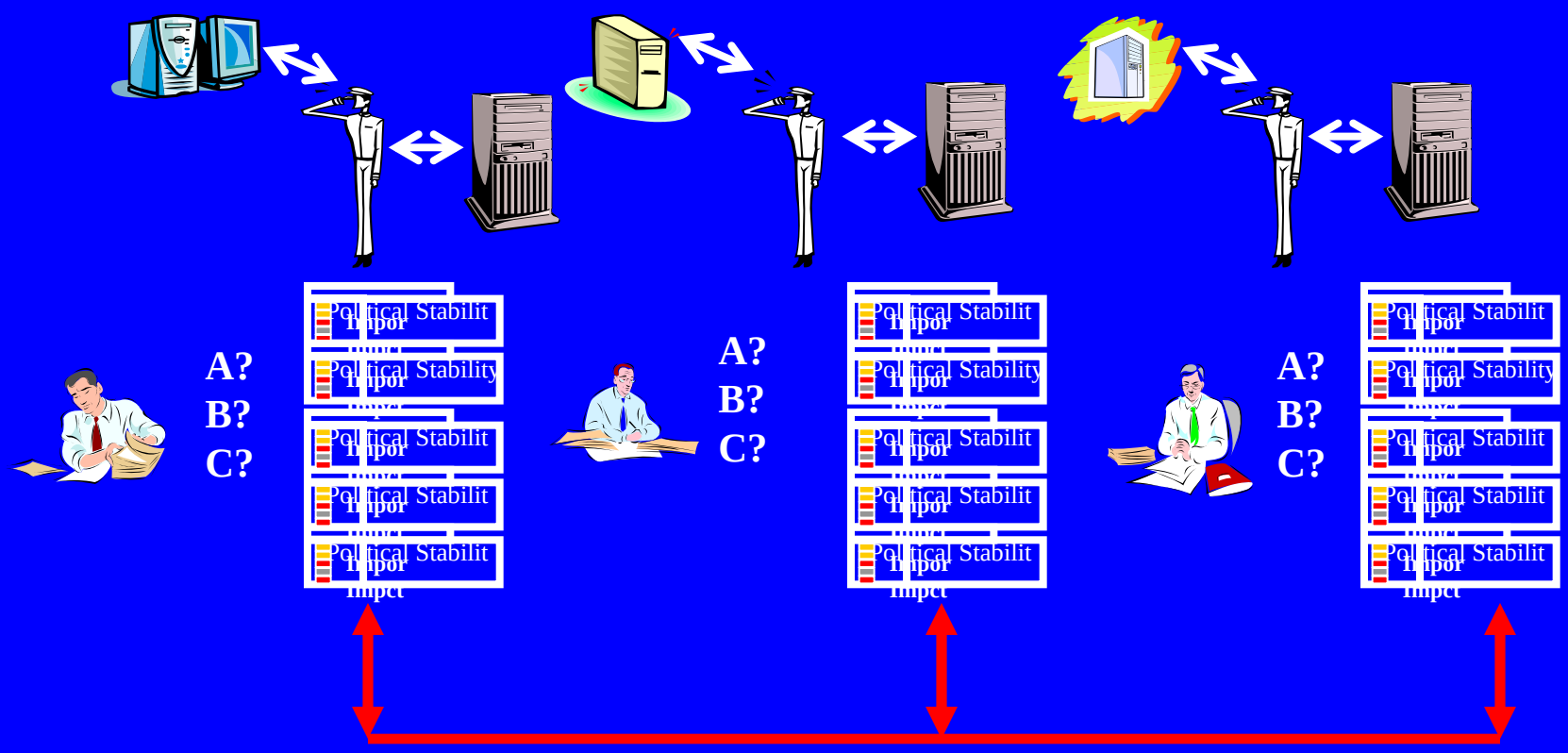
A3: Duration of Ops

A4: Local Security

A5: Infrastructure

Consensus Overall Recommendation:
Mild Endorsement

Decision Flow Model (Revised)

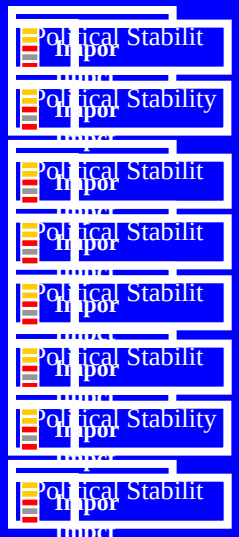


Unique Items are shared

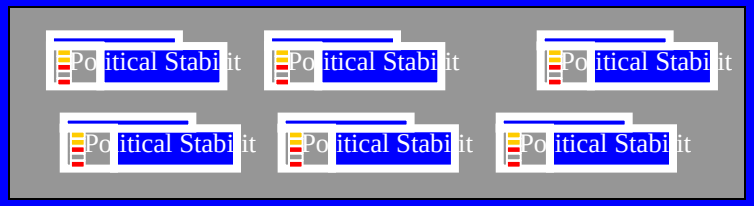
Decision Flow Model (cont.)

EWALL Technology

Each participant has a uniform pool of items



A?
B?
C?
all?



A?
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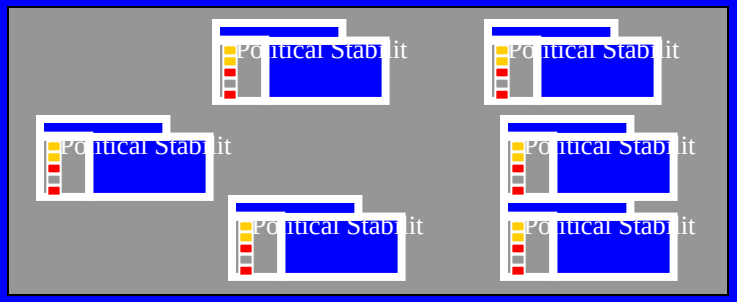
C?
All?



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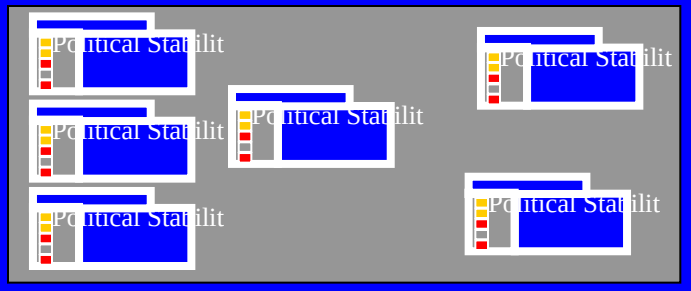
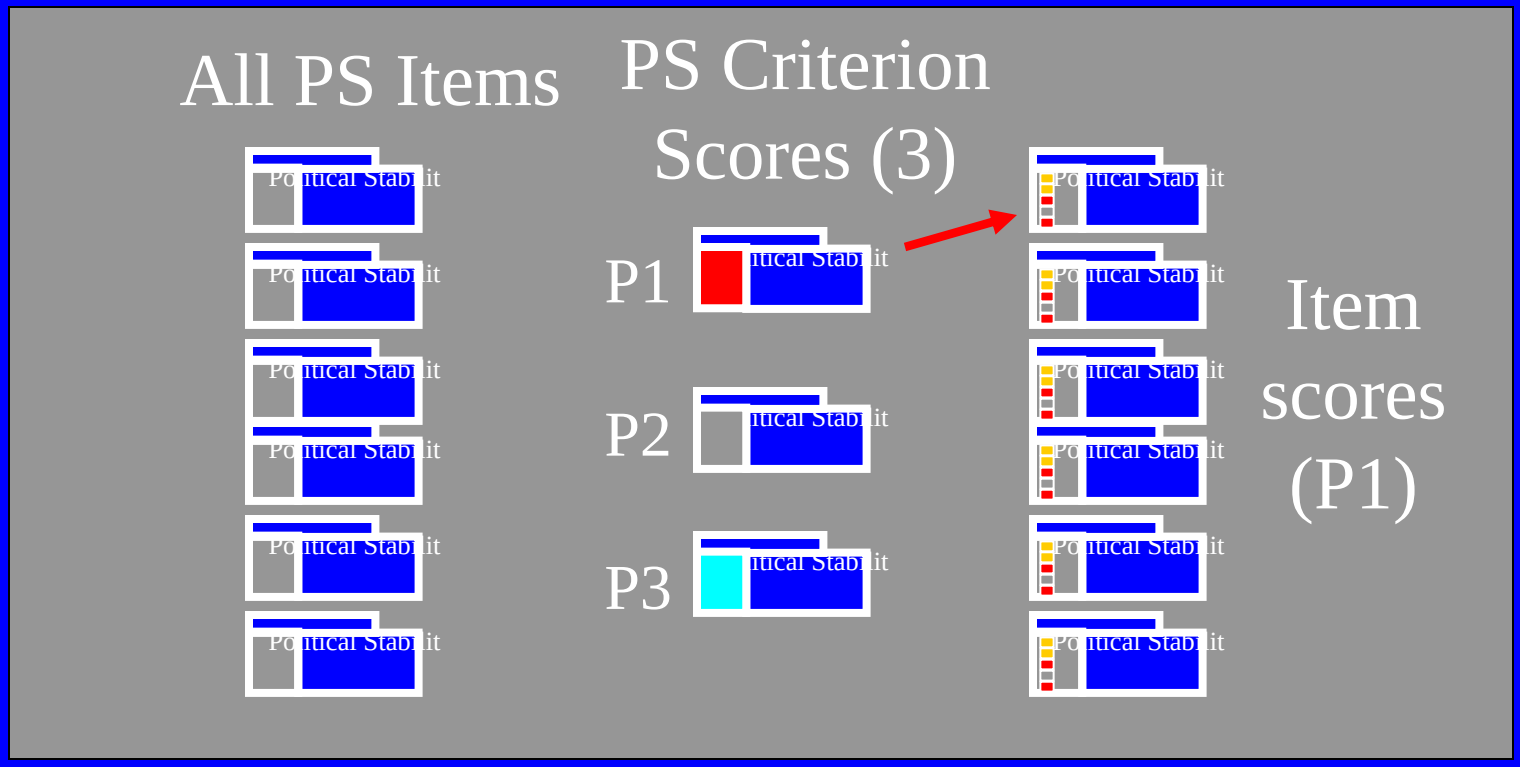


Collaboration & Consensus Building (PS Criterion)

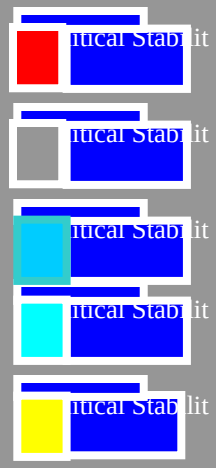
Networked EWALL Computer Display



Group Overall Decision

Networked EWALL Computer Display

Group Criteria Scores



Overall Scores (3)

P1

P2

P3

Completed Experiments

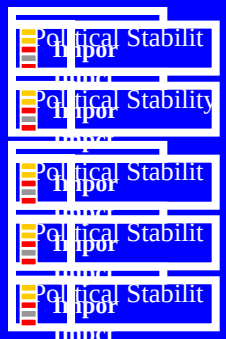
- Two experiments completed in FY02
- Primary focus was on what type of information the subject would request to reconcile differences with the “group”
- Subjects focused on maximum discrepancies with “other group members” vice attempting to move mid-point scores to a consensus
- One experiment showed significant preference for looking at scores higher than their own (i.e. more positive)
  - second experiment showed opposite result

Planned Experiment

- **Structure & Tagging Experiment**
- Design/software completed, pilot subjects tested
- Experiment is on-line, internet based
  - At http://64.66.5.34:8080/dcode
- Expect to use Ss at NPS, run Jan/Feb.

Experimental Design Overview

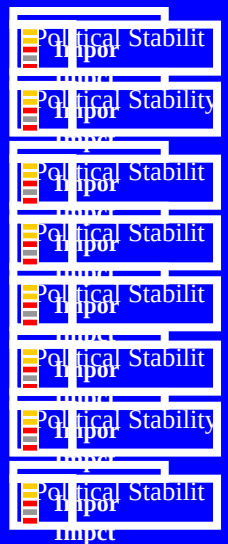
Original Pool of Items



A?
B?
C?
all?

Phase I

Composite pool of items (UI+SI)



A?
B?
C?
all?

Phase II

Research Question:

Does the manner in which these are displayed, influence the accuracy of the revised assessment?

Structrure & Tag Experiment

- Subject sees 12 information items
  - 4 Criteria, 3 information items per Criterion
  - Scores all the criteria, plus an overall socre
  - Then sees 10 new items which are UI from other members (e.g. automated browser search)
    - UI creates **hidden profile** situation, i.e. Negative changes to Positive with information pooling
  - Then scores his constructs again after seeing the UI
- Three Presentation Modes (Between Ss variable)
  - Randomized lists of the 12 and the 12+10 items
  - The 12 and 12+10 item lists are grouped (but not tagged)
  - The 12 and 12+10 item lists are grouped and tagged

Impact of UI Information

	First 12 items	Add the 10 UI items
Criterion 1	2 NEG 1 POS "NEG"	2 NEG 4 POS "POS"
Criterion 2	2 NEG 1 POS "NEG"	2 NEG 4 POS "POS"
Criterion 3	2 NEG 1 POS "NEG"	4 NEG 1 POS "Strong NEG"
Criterion 4	2 POS 1 NEG "POS"	4 POS 1 NEG "Strong POS"
Overall Score	NEG	POS

List Condition (First 12)

"....The major ports of Islandia are less than three days sailing from our major disaster recovery supply center at Naha. Naha also has three supply ships that are permanently loaded to be used in quick response assistance...."

"....Islandia Security Forces are used to working in small independent groups, and as such have never really developed expertise in larger scale command and control operations such as this camp would required. There is some question as to whether they will be able to effectively perform a mission of this large scale...."

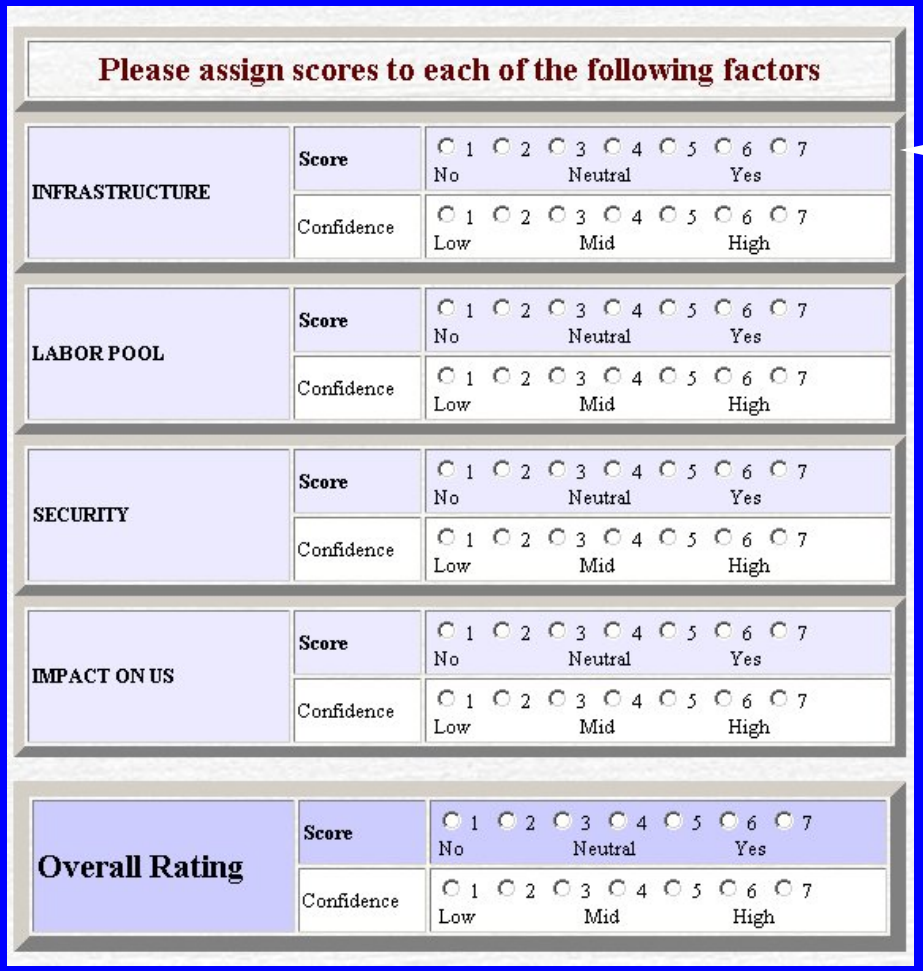
"....The Huan Construction Company announced last month that it had completed all the work on Aurgon, Islandia's major airport. The major impact of this construction is that the airport will now be able to handle even the largest commercial and military jet aircraft...."

"....Our Ambassador to Islandia been at that job longer than any other in the region, and has a very good relationship with all levels of the Islandia government. This should assure that any negotiations between us and Islandia would go very quickly and without any major difficulties...."

"....A detailed report on both the primary and secondary roads in Islandia indicates that within and between all the major cities, almost all of the primary roads are four lanes. The vast majority of the secondary roads are good quality two-lane highways...."

"....In the past eighteen months, a number of large manufacturing plants have opened in Islandia. As a consequence, the unemployment rate is quite low. Some companies have reported difficulties in attracting a local labor force, and some have been forced to bring in foreign workers...."

Scoring the information



Please assign scores to each of the following factors		
INFRASTRUCTURE	Score	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
LABOR POOL	Score	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
SECURITY	Score	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
IMPACT ON US	Score	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
Overall Rating	Score	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High

Generic KE design was not used

- KE design had not been finalized during software development.
- Felt a finer degree of granularity might be needed to highlight differences (7-pt. Scale vs. 5-pt. Scale)
- Only one tagging parameter (impact, pos-neg) was used for tagged condition.

List Condition: UI Items (appended to end of list)

"....Last year a World Bank survey listed Islandia's labor force as having the highest literacy rate of any country in the region. This has been true for the last nine annual surveys, and it attributed to Islandia's emphasis on giving every child access to a free education...."

"....Members of Islandia's Security Forces are hand picked by government agencies. As such, the members feel strong allegiance to the central government. Their loyalty to the government and their immediate compliance to government orders and directives has never been an issue. They do as they are ordered by the Islandia government...."

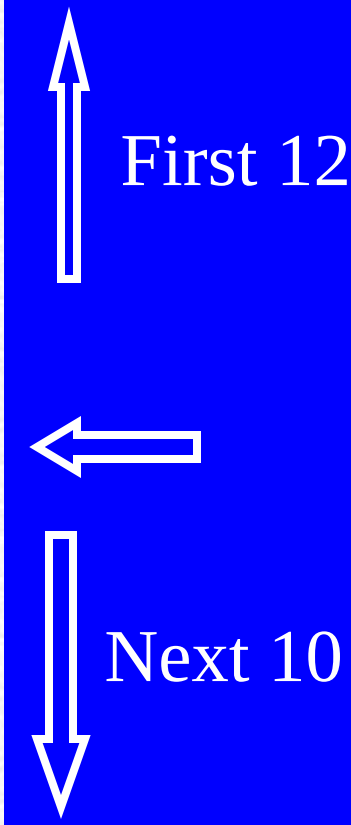
"....The Security Force proposed for the camp is of adequate size but there is concern that should another emergency appear--and with the oncoming monsoon season, that is a strong possibility--the Security Forces would not be able to cover both the camp and the other disaster. In that case, the Islandia government would almost assuredly give top priority to the new disaster, leaving the camp with insufficient protection...."

"....The Islandia News reported the two Northern Provinces experienced a six-hour loss of electric power during the night. This is the seventh time this month that there has been a prolonged power loss, indicating that Islandia has still not solved its chronic problem of failing to have a reliable power grid system in any part of the country other than the Capital region...."

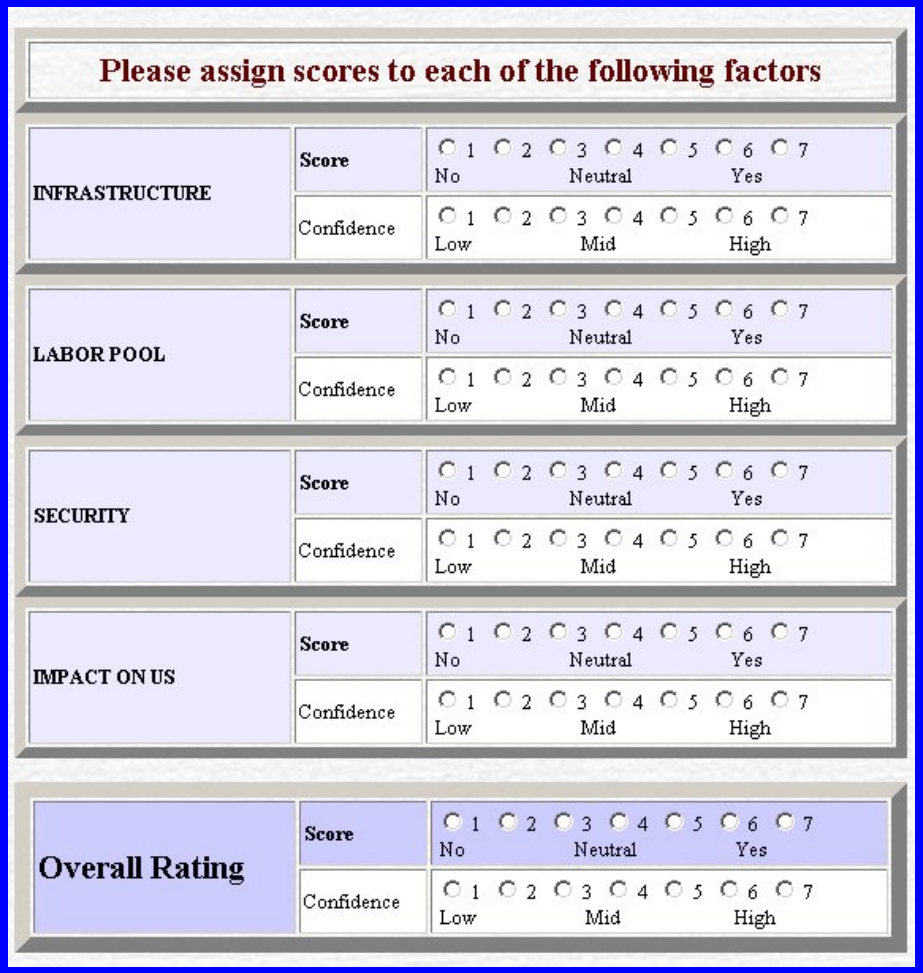
"....The most recent issue of the Asian Times carries an excerpt from a Doctors Without Borders report highlighting the serious sewer/waste disposal conditions they found in rural Islandia. Many of the large sewer pipes/drains were found to be old and leaking, and, if not repaired quickly by the government, these medical personnel felt there could be serious health issues...."

"....A cultural tradition in Islandia is that each worker is given a single two month vacation each year, which he can take any time during the year. All the employee has to do is give the employer a one week notice before going on vacation. This has caused unexpected and disrupted work shortages when several employees elect to take the vacation at the same time...."

"....With the Islandia government supplying the bulk of the Security Forces, we should have to send only a minimum number of our uniformed military to the camp. This would therefore have virtually no effect on the ability of our command to respond to some new, unplanned crisis...."



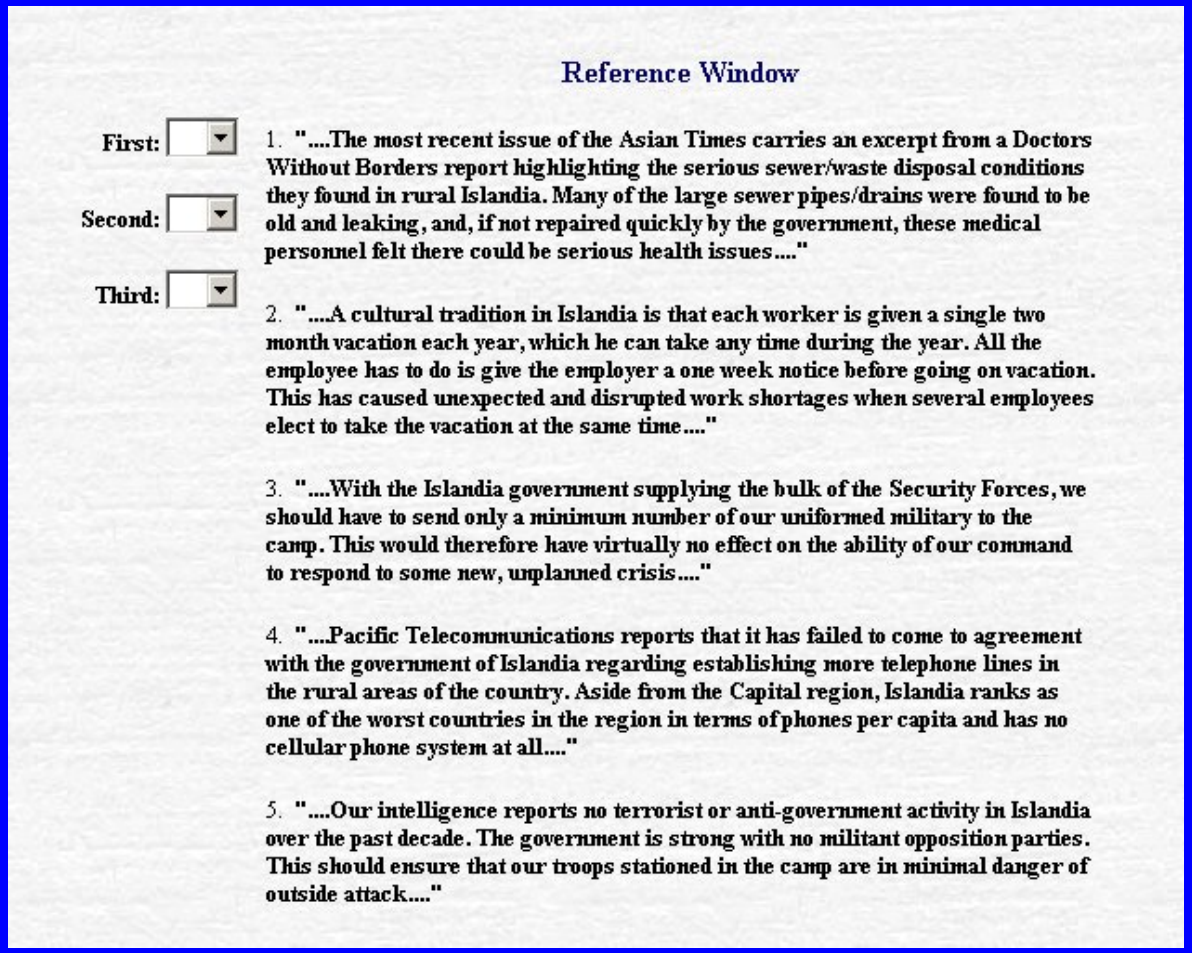
Scoring the information again after seeing UI items



Please assign scores to each of the following factors

INFRASTRUCTURE	**Score**	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
LABOR POOL	**Score**	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
SECURITY	**Score**	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
IMPACT ON US	**Score**	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High
Overall Rating	**Score**	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 No Neutral Yes
	Confidence	○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 Low Mid High

Which UI items were most important?



⇐ The 10 UI items

We would expect he selects the hidden profile reversal items

Grouped Condition: First 12

*** INFRASTRUCTURE ***

"....The Huan Construction Company announced last month that it had completed all the work on Aurgon, Islandia's major airport. The major impact of this construction is that the airport will now be able to handle even the largest commercial and military jet aircraft...."

"....A detailed report on both the primary and secondary roads in Islandia indicates that within and between all the major cities, almost all of the primary roads are four lanes. The vast majority of the secondary roads are good quality two-lane highways...."

"....The Islandia News reported the two Northern Provinces experienced a six-hour loss of electric power during the night. This is the seventh time this month that there has been a prolonged power loss, indicating that Islandia has still not solved its chronic problem of failing to have a reliable power grid system in any part of the country other than the Capital region...."

*** LABOR POOL ****

"....In the past eighteen months, a number of large manufacturing plants have opened in Islandia. As a consequence, the unemployment rate is quite low. Some companies have reported difficulties in attracting a local labor force, and some have been forced to bring in foreign workers...."

"....Last year a World Bank survey listed Islandia's labor force as having the highest literacy rate of any country in the region. This has been true for the last nine annual surveys, and it attributed to Islandia's emphasis on giving every child access to a free education...."

"....Worker productivity in Islandia has been difficult to assess due to their record keeping methods and governmental control over the release of the data. However, a recent survey of multinational companies with plants in Islandia indicates that they feel their plants in Islandia are always among their most productive..."

Items grouped by criteria

Grouped Condition:
UI items appended to end of category list

*** INFRASTRUCTURE ***

"....The Huan Construction Company announced last month that it had completed all the work on Aurgon, Islandia's major airport. The major impact of this construction is that the airport will now be able to handle even the largest commercial and military jet aircraft...."

"....A detailed report on both the primary and secondary roads in Islandia indicates that within and between all the major cities, almost all of the primary roads are four lanes. The vast majority of the secondary roads are good quality two-lane highways...."

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"....A recent magazine article, in response to the upcoming monsoon season, noted the deplorable history that Islandia's Dept. of Roads has in repairing the road and bridge damage inflicted by the monsoon rains. While the road system itself in Islandia is considered quite adequate, repairs to damaged roads and bridges often takes several weeks, causing excessive delays or leaving areas totally inaccessible...."

"....The most recent issue of the Asian Times carries an excerpt from a Doctors Without Borders report highlighting the serious sewer/waste disposal conditions they found in rural Islandia. Many of the large sewer pipes/drains were found to be old and leaking, and, if not repaired quickly by the government, these medical personnel felt there could be serious health issues...."

"....Pacific Telecommunications reports that it has failed to come to agreement with the government of Islandia regarding establishing more telephone lines in the rural areas of the country. Aside from the Capital region, Islandia ranks as one of the worst countries in the region in terms of phones per capita and has no cellular phone system at all...."

Tagged Condition (First 12)

*** INFRASTRUCTURE ***

THIS ITEM IS RATED AS POSITIVE - "....The World Health Organization recently cited Islandia as an outstanding example of a nation addressing health issues. Specifically noted was the completion of their Potable Water Initiative (PWI), a three-year program directed at giving every village with a population of over 150 either a large storage supply of potable water or access to a high-output Reverse Osmosis machine to produce the required potable water supply...."

THIS ITEM IS RATED AS POSITIVE - "....A detailed report on both the primary and secondary roads in Islandia indicates that within and between all the major cities, almost all of the primary roads are four lanes. The vast majority of the secondary roads are good quality two-lane highways...."

THIS ITEM IS RATED AS NEGATIVE - "....Pacific Telecommunications reports that it has failed to come to agreement with the government of Islandia regarding establishing more telephone lines in the rural areas of the country. Aside from the Capital region, Islandia ranks as one of the worst countries in the region in terms of phones per capita and has no cellular phone system at all...."

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THIS ITEM IS RATED AS NEGATIVE - "....Past regional conflicts in the area have caused hostile feelings among the different cultures and countries. Some of the evacuated refugees will be from Tammni, a country that in the past has had poor relations with Islandia. Islandia workers may not be willing to work at the camp if they perceive that they are, in part, helping Tammni residents...."

THIS ITEM IS RATED AS POSITIVE - "....The salary and benefits paid to Islandia workers has been compared against ten other countries in the region. The findings vary as a function of the specific issue addressed, but in almost all of the comparisons, Islandia workers are in the lower half in terms of salary and benefits paid...."

Items grouped and tagged as Positive or Negative influence on criteria.

Tagged Condition:
UI items appended to end of category list

*** INFRASTRUCTURE ***

THIS ITEM IS RATED AS POSITIVE - "....The World Health Organization recently cited Islandia as an outstanding example of a nation addressing health issues. Specifically noted was the completion of their Potable Water Initiative (PWI), a three-year program directed at giving every village with a population of over 150 either a large storage supply of potable water or access to a high-output Reverse Osmosis machine to produce the required potable water supply...."

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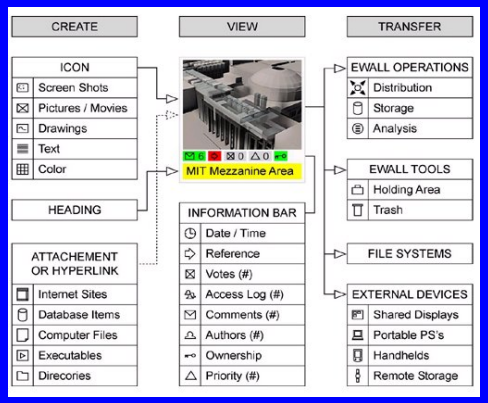
Hidden Profile

Experimental Hypotheses

- **List condition**
  - **Will not detect the hidden profiles**
  - **Least accurate scoring of criteria**
  - **Low confidence**
  - **Longest completion time**
- **Tagged condition**
  - **Will detect the hidden profiles**
  - **Most accurate scoring of criteria**
  - **Highest confidence**
  - **Shortest completion time**
- **Grouped Condition**
  - **Middle range between List and Tagged conditions**

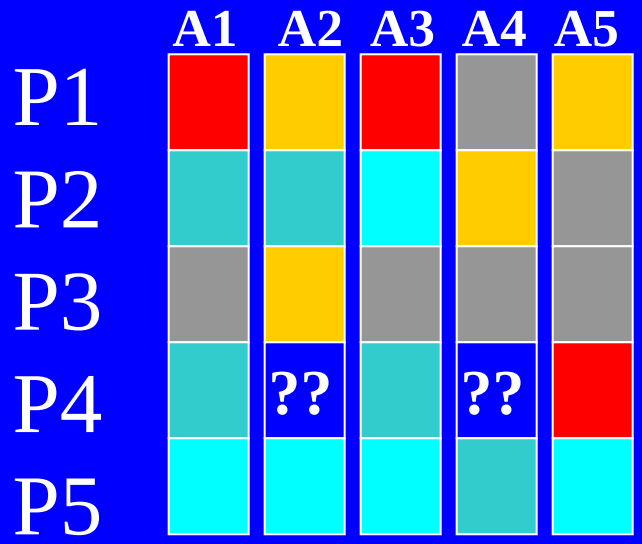
Additional FY03 Work

Optimized KE techniques/displays:
What information is required,
how should it be elicited?



Compatibility with, leveraging of
EWALL technologies

Five Criteria



Interface/displays for
group consensus building

Presentations/Publications

- Fleming, R. Use of Shared and Uniquely Held Information in a Distributed Collaborative Environment. Paper presented at HFE TAG, June 2002
- Fleming, R. A 'Tag and Release' Approach to Information Exchange in Crisis/Disaster Situations. Paper Presented at HFE TAG, June 2002
- Fleming, R. Information exchange in group decision making: Review and impact on command and control. Paper Presented at HFE TAG, Nov. 2002
- Fleming, R. and Kaiwi, J. The Problem of Unshared Information in Group Decision-Making: A Summary of Research and a Discussion of Implications for Command and Control. SSC-SD Technical Document 3149, July, 2002

References/Bibliography

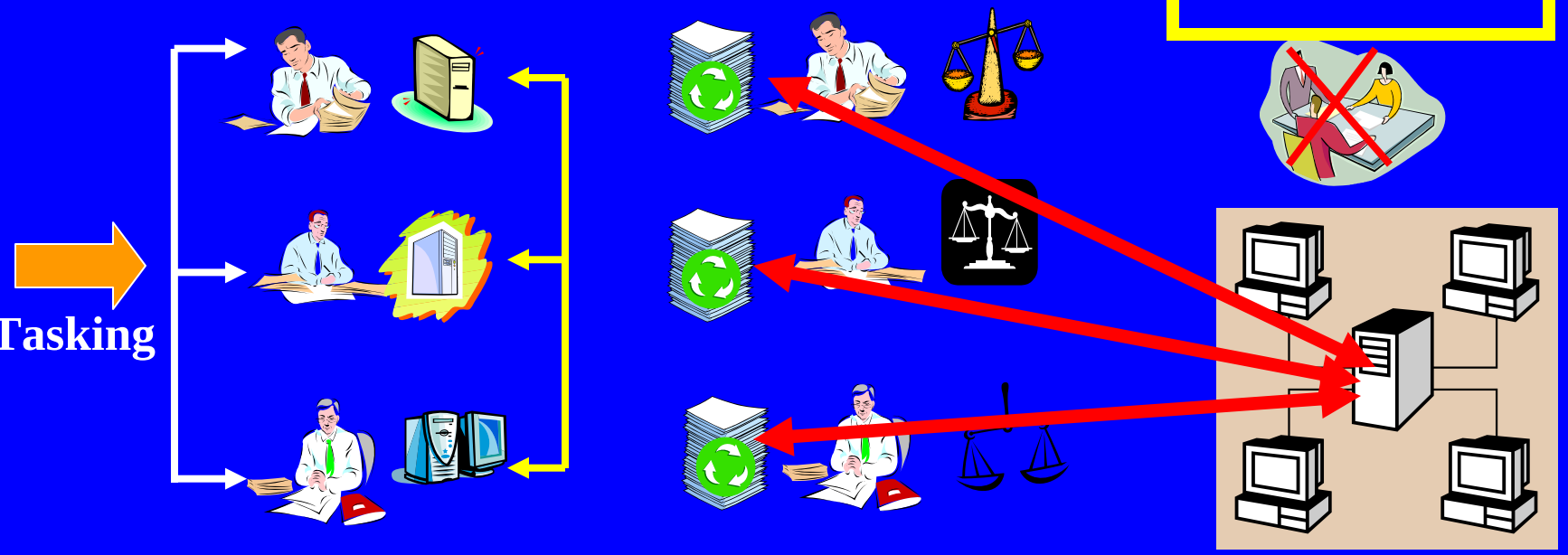
- Large Bibliography included in SSC-SD Technical Report:

Fleming, R. and Kaiwi, J. The Problem of Unshared Information in Group Decision-Making: A Summary of Research and a Discussion of Implications for Command and Control. SSC-SD Technical Document 3149, July, 2002

Asynchronous Collaboration

Time

Group (collect, exchange)

Individual evaluation

Group Consensus