

Elements of information origination process and causes of uncertainties therein

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Course Lecture # 24

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Lecture # 24

Elements of information origination process and causes of uncertainties therein

OVERVIEW-1

- Recap
- Information Origination Processes
- Elements of information origination situation
- Causes of uncertainties in elements of Core *IS*
- Uncertainties in *Observation* Element are caused by...
- Uncertainties in *Verification* Element are caused by...
- Uncertainties in *Problem Recognition* Element are caused by...
- Uncertainties in *Prediction of Future States*' Element are caused by...

OVERVIEW-2

- Uncertainties in *Precompiled Responses* and *Abstract Reasoning's* Element are caused by...
- Uncertainties in Element of *Coordination of Activities via Supervisory (Informational) Control* Are Caused By...
- Uncertainties in Element of *Action Planning and Action Scheduling* Are Caused By...
- Uncertainties in *Reevaluation* Element Are Caused By...
- Uncertainties in *Information Origination Resource Management* Element Are Caused By...
- Summary

RECAP - 1

- In Lecture # 20 we studied that open system view of the business process *IS* view comprises a multistage decision process, which is a continuous individual information origination (and processing) situation in the presence of uncertainty.
- In Lecture # 21 we saw that the information originated is given by an information envelope, which presents a maximal information and is impacted by uncertainties.
 - Information bases comprising the maximal information cognize environment. It is the loss of integrity in cognizing environment that gives rise to uncertainties.

RECAP - 2

- Thus what we have is the (business process) *IS* view with uncertainty.
- It is made of multiple of information systems that the decision stages are, each having its own variety of uncertainty.
- Further, such *IS* originates maximal information by the way of information envelope comprising information bases. Each information base has its own type of uncertainty.
- That is we have both information originating processes – the information systems - and information there from both characterized by uncertainty.

INFORMATION ORIGINATION PROCESSES-1

- Business process *IS* view is a continuous individual information origination situation in the presence of uncertainty.
 - This comprises decision situations in the presence of uncertainty.
- In the form of information envelope, the business *IS* originates endogenous to decision situation:
 - Problem Information (normative as well as factual),
 - Problem Environment Information, and
 - Problem Solution Alternatives Information.

INFORMATION ORIGINATION PROCESSES-2

- Evaluation of the alternatives is why these information types are originated.
- Towards this objective the problem information structure (system) dynamics model (state space equation) is developed based on the normative information.
- Thus the above *IS* dynamics model cognizes about the internal and external problem (system) environment.
 - In concrete terms, this facilitates generation of alternatives endogenous to decision situation under consideration.

INFORMATION ORIGINATION PROCESSES-3

- It is by inputting (processing) the collected current factual problem data through the state space equation (*IS* dynamics) model, so developed, that the problem solution alternatives, which are generated endogenous to decision situation, are evaluated.
- This leads to the optimum flexible information decision for control implementation.

INFORMATION ORIGINATION PROCESSES-4

- What is significant is all through its tasks of information origination, i.e., cognizing environment and evaluating alternatives to select the flexible, individual situation information decision, the *IS* view involves decision stages.
- And each of these decision stages is also an information origination situation.

INFORMATION ORIGINATION PROCESSES-5

- In a complex and changing environment, this makes for information origination process as a core information system.
- References:
 - Gaba, D., Howard, S. & Fish, K., “Crisis management in anesthesiology”, New York: Churchill-Livingstone, 1994.
 - David M. Gaba, “Human Error in Dynamic Medical Domains”, In Human Error in Medicine, Edited by Marilyn Sue Bogner, Lawrence Erlbaum Associates, New Jersey, 1994.

ELEMENTS OF INFORMATION ORIGINATION SITUATION-1

- What are the elements of the core *IS*, which is an information origination process?
- Each of the decision processes under the business process *IS* view comprises a repeated loop – in series and parallel - of observation, decision, action, and reevaluation.

ELEMENTS OF INFORMATION ORIGINATION SITUATION-2

- Accordingly, the core *IS* originating information comprises **individual elements**. These are:
 - Observation of the real world events,
 - Verification,
 - Problem Recognition,
 - Prediction of Future States,
 - Precompiled Responses and Abstract Reasoning,
 - Coordination of activities via Supervisory control,
 - Action Planning and Action Scheduling,
 - Action Implementation,
 - Reevaluation, and
 - Information Origination Resource Management.

CAUSES OF UNCERTAINTY IN ELEMENTS OF CORE IS

- Each of the elements of the core *IS*, which is an information origination process, has uncertainties.
- These uncertainties are caused by informational errors in processing information at the elements, which in turn leads to core *IS* errors, which in turn results in decision errors at each of the multi decision stages, and, thereby, in business *IS* view errors (Refer Lectures # 19, 21).
- Thus, it is by mitigating the effects of information errors in each of the elements of the core information origination processes (i.e., by controlling their I*I) that business decision errors and hence the business *IS* errors, i.e., the business errors can be minimized (i.e., their I*I can be controlled).

UNCERTAINTIES IN **OBSERVATION** ELEMENT ARE CAUSED BY.. 1

- Organizations (i.e., businesses, systems) are being described increasingly by their information systems (*IS*), which manage information flow situations (across the supply chain) that are dynamic decision processes.
- Characteristics of the observation element:
Operation of the *IS* as this depends on responding to changing information, of which the *IS* has many sources. These include:
 - Technical observation of the subject, i.e., feedback form the subject of observation,
 - A multitude of displays from electronic monitors,
 - Visual inspection by field level operators, technical inspectors,
 - Abnormal sounds of equipments, instruments, people,
 - Laboratory test reports, etc.

UNCERTAINTIES IN OBSERVATION ELEMENT ARE CAUSED BY.. 2

- Uncertainties are caused in observation due to following **information errors**:
 - Not observing/sensing a data/information stream at all,
 - Not observing/sensing a data/information stream frequently enough,
 - Not observing/sensing the data/information stream given the existing situation
- These information errors are caused due to:
 - Uncertainty in Supervisory Control (\$1) resulting in
 - Loss of overall vigilance (\$1.1),
 - Due to impairment of sensors and instruments,
 - Due to impairment of human operators,
 - » Due to performance-shaping factors such as fatigue, illness, lack of motivation, attitudes of invulnerability, drugs, etc.,
 - Loss of capacity to sustain attention (\$1.2),

UNCERTAINTIES IN **OBSERVATION** ELEMENT ARE CAUSED BY.. 3

- Uncertainty in resource management (\$2) due to
 - Failure to attend to all relevant information (\$2.1)
 - Due to excessive attention being paid to only a subset of data/information stream (\$2.1.1),
 - Even perfect allocation of observation can be overwhelmed by the sheer amount of information and the rapidity with which it is changing (\$2.1.2)
 - » In this circumstance, even the perfect sensor or human observer cannot switch attention between multiple data sources fast enough to keep up with the dynamism of the environment.

UNCERTAINTIES IN VERIFICATION ELEMENT ARE CAUSED BY.. 1

- Uncertainty in environmental information
 - Not only is there a great deal of information in the complex and constantly changing environment, but that information is not always reliable.
- Uncertainty in information origination process
 - Most environment monitoring for information origination uses relatively weak signals detectable at the boundary/surface of the environment (to avoid invading environment more than is necessary, to keep costs of monitoring hardware low). This makes it easily prone to *artifacts* (false data).

UNCERTAINTIES IN VERIFICATION ELEMENT ARE CAUSED BY.. 2

- Even direct observations such as vision or listening by human operators can be ambiguous. This can lead to brief *transients* (true data of short duration).
- *Artifacts* or *transients* will typically correct themselves quickly.
- However, if either artifacts or transients are incorrectly interpreted as indicating major problem requiring a strong response, unnecessary and risky actions might be taken (\$).

UNCERTAINTIES IN VERIFICATION ELEMENT ARE CAUSED BY.. 3

- Verification uses variety of methods, including:
 - Repeating the observation or observing short term trend,
 - Observing an existing redundant channel,
 - Correlating multiple related variables,
 - Activating a new monitoring modality,
 - Recalibrating an instrument or testing its function,
 - Replacing an entire instrument with a backup device,
 - Asking for a second opinion.

UNCERTAINTIES IN VERIFICATION ELEMENT ARE CAUSED BY.. 4

- Uncertainty in the process of verification (\$)
 - Knowing when and how to verify data/information is an important meta-informational skill. The decision making process has to decide under what conditions it is useful to invest time, information origination resource, and energy in establishing a new source of information, as opposed to relying on more indirect information sources that are already in place.
 - Conversely, failure to verify data/ information properly can result in devoting excessive information origination resources to a non problem or to taking actions that are more dangerous than the underlying event.

UNCERTAINTIES IN **PROBLEM RECOGNITION** ELEMENT ARE CAUSED BY..1

- Having made and verified observations, the next step is to decide if they indicate no problem or if a problem is occurring, that is, if there is environmental, i.e., informational anomaly or deviation.
- If a problem is found, a decision must be made as to its nature (e.g., explicit or implicit) and importance (prioritization).
- This process of problem recognition is central to information origination by systems performing in complex environment.

UNCERTAINTIES IN **PROBLEM RECOGNITION** ELEMENT ARE CAUSED BY..2

- Problem recognition involves matching sets of cues (data/information) in complex and changing environment to patterns that are known to represent specific types of problems.
- Here a common type of **information error** is to observe the signs of a problem but to fail to *recognize* them as problematic.
- This information error is because recognition calls for application of information origination resource, which is costly. This is because there are alternate uses of resource (\$).
- Further this information error is also made more likely by the fact that the existing cues are dynamically changing and are ambiguous (\$).

UNCERTAINTIES IN **PROBLEM RECOGNITION** ELEMENT ARE CAUSED BY..3

- Even when a problem is detected or recognized, the cues may not specify an unique cause (\$).
- This brings in requirement for supervisory control in the form of what to do when a clear cut match or “diagnosis” cannot be made.
- Dynamic decision making processes use approximation strategies – termed heuristics - to handle these ambiguous situations.

UNCERTAINTIES IN **PROBLEM RECOGNITION** ELEMENT ARE CAUSED BY..4

- Heuristic 1: One heuristic is to categorize an event as an instance of one of a variety of generic problems, each of which encompasses many different underlying conditions. Although the exact diagnosis underlying the generic problem may not be immediately apparent, there can be generic solutions that are appropriate for all diagnoses in the class (this has cross reference to pre-compiled responses).
- Heuristic 2: Another heuristic that can be used when there are multiple possible diagnoses (i.e., problem solving goals) is to gamble on a single specific diagnosis, betting initially on the occurrence of the candidate that is most frequently encountered (literature terms this frequency gambling).

UNCERTAINTIES IN **PROBLEM RECOGNITION** ELEMENT ARE CAUSED BY..5

- Under Heuristic 2, the decision making process, which (by the way of problem recognition) selects the single specific problem solving goal, may rearrange an informational “index of uncertainty” for recognizing certain specific problems that can be anticipated for *that* recipient (which could be an object (concrete or abstract), human, communication, rule, norm, policy, command, financial mechanism, etc.).
 - The decision-making must also decide when a single underlying problem goal explains all of the data/information or whether the data/information indicate multiple simultaneous causes (\$).
 - This decision is important because excessive attempts to refine the problem solving goals can be very costly in terms of information origination resources (i.e., allocation of attention for say human decision maker) and may prevent the real goal being adequately addressed.
- Heuristics (approximation strategies) are used in decision making so as to yield considerable time saving in dealing with problems.
 - On the flip side both heuristics - frequency gambling and inappropriate allocation of information origination resources solely to expected problems- can seriously derail problem solving when these gambles do not pay off.

UNCERTAINTIES IN PREDICTION OF FUTURE STATES' ELEMENT ARE CAUSED BY..1

- Problems (environmental anomalies) must be assessed in terms of their significance for the *future* condition of the customer/ recipient.
- Predicting future states based on the occurrence of seemingly trivial problems (local knowledge factors or non critical environmental anomalies, which starting small come with delay and impact critical system factors) is a major part of processing anticipatory information influencing outcomes of the dynamic decision making process.

UNCERTAINTIES IN PREDICTION OF FUTURE STATES' ELEMENT ARE CAUSED BY..2

- Specifically, these predictions should influence the priority given to problems because those that are immediately threatening or are likely to evolve into critical incidents deserve the highest priority. Prediction of the future states should also influence action planning by defining time-frame available for required actions.
- In view of above, possible errors here are:
 - Failure to predict the evolution of catastrophic consequences from the early stages of a problem,
 - Failure to use predictions in assigning priorities to tasks during action planning.

UNCERTAINTIES IN *PRCOMPILED RESPONSES* AND *ABSTRACT REASONING'S* ELEMENT ARE CAUSED BY ..1

- Having recognized a problem, how does the decision making process decide?
- The classical paradigm of decision making postulates a careful comparison of the evidence with various causal hypotheses that could explain them. This is supposed to be followed by a careful analysis of all possible actions and solutions to the problem.
 - This approach although powerful, is relatively slow and does not work well with ambiguous or scanty evidence. It is rarely seen in real-world problem-solving situations.

UNCERTAINTIES IN *PRCOMPILED RESPONSES* AND **ABSTRACT REASONING'S** ELEMENT ARE CAUSED BY ..2

- Many real world problem solving situations require quick action to prevent a rapid degeneration (cascading) to a catastrophic adverse outcome, and for these problems, deriving a solution through formal deductive analysis (reasoning) from “first principals” is just too slow.
- The initial decision making practices in responding to such situations/ events arise from *pre compiled responses* to these type of events. In literature this has been referred to as “recognition-primed decision making”.
 - Appropriately designed decision making processes can rapidly retrieve and execute precompiled responses to common problems.
 - During pre problem solving (i.e., pre control implementation) stages, the decision making process may (information integrity risk wise) reorder and simulate (rehearse) these responses based on the recipient’s benefit, the implementation procedure, and problems to be expected.

UNCERTAINTIES IN *PRCOMPILED RESPONSES* AND *ABSTRACT REASONING'S* ELEMENT ARE CAUSED BY ..3

- Failure to do so can be considered an error because it renders sub-optimal the ability of the decision making process to respond quickly and correctly to the recipient 's needs, i.e., to maximize the net information decision *use* (\$).
- Pre-compiled responses usually are acquired through situation documentation often by the way of human experiences; only a few that involve catastrophes may be explicitly codified and taught systematically. Thus most situational documentation often is haphazard, making it less than optimally prepared to respond to complex to highly critical events (\$).
- Although well thought out precompiled responses can provide quick, if partial, solutions to problems, they are certain to fail when the problem is not due to the suspected cause or when it does not respond to usual measures. Conducting problem solving purely by precompiled “cookbook” procedures is not desirable (\$).

UNCERTAINTIES IN **PRCOMPILED RESPONSES AND ABSTRACT REASONING'S** ELEMENT ARE CAUSED BY ..4

- Therefore, even when quick action is required, careful reasoning about the problem utilizing fundamental knowledge in respect of the event is also desired in the background while precompiled responses are being executed.
 - This kind of abstract reasoning may involve a search for high-level analogies or true deductive reasoning from the deep knowledge based careful analysis of all possible solutions (the classical decision paradigm).

UNCERTAINTIES IN **PRCOMPILED RESPONSES AND ABSTRACT REASONING'S** ELEMENT ARE CAUSED BY ..4

- The degree to which abstract reasoning is mixed in with procedural reasoning during the management of critical incidents through dynamic decision making is not known at this time. Clearly, performance will be sub-optimal if the problem solver cannot successfully merge precompiled responses with abstract reasoning when standard approaches are not succeeding (\$).

UNCERTAINTIES IN ELEMENT OF **COORDINATION OF ACTIVITIES VIA SUPERVISORY (INFORMATIONAL) CONTROL** ARE CAUSED BY ...1

- Each element of the core *IS* has its own uncertainties. These uncertainties result from information errors that characterize elements. In other words, elements, which are also information systems, originate information in their own right and in the process have information errors.
- Thus what we have are core *IS* and their elements - all information origination processes with uncertainties. Further, they all have information errors.

**UNCERTAINTIES IN ELEMENT OF COORDINATION OF
ACTIVITIES VIA SUPERVISORY (INFORMATIONAL)
CONTROL ARE CAUSED BY ...2**

- This calls for coordination of information origination process activities and tasks. This is achieved via the element of supervisory control, which in fact is an informational control.
- Information origination process activities and tasks is an informational workload. Management of informational workload is achieved by:
 - Distributing informational workload over time,

UNCERTAINTIES IN ELEMENT OF **COORDINATION OF ACTIVITIES VIA SUPERVISORY (INFORMATIONAL) CONTROL ARE CAUSED BY ...3**

- The decision making process prepares for future tasks when the current informational workload is low (preloading), and delays or sheds low priority tasks when the current load is high (offloading).
- The interleaving of tasks together (multiplexing) is another example of distributing workload over time.
- Distributing informational workload over resources,
 - When workload cannot be distributed over time, and when additional non-competing resources are available, task loads can be distributed, and by
- Changing the nature of the task,
 - Tasks can be postponed. Tasks can be performed to different standards of performance. As the standards are loosened, the workload required to perform them is reduced.

UNCERTAINTIES IN ELEMENT OF **COORDINATION OF ACTIVITIES VIA SUPERVISORY (INFORMATIONAL) CONTROL ARE CAUSED BY ...4**

- Supervisory control level reduces informational errors in elements of information origination process by:
 - Determining how frequently different information streams are observed,
 - Indicating when and how to verify data,
 - Deciding on what priorities are given to routine tasks (i.e., with no information flow) versus problem solving, and
 - Scheduling actions so that necessary information origination and control resources are available to execute them.

UNCERTAINTIES IN ELEMENT OF **COORDINATION OF ACTIVITIES VIA SUPERVISORY (INFORMATIONAL) CONTROL ARE CAUSED BY ...5**

- The intensive information origination activity demands can easily exhaust available information origination resources.
- Therefore, the ideal decision making strikes a balance between:
 - Deciding on flexible information decision quickly on every small perturbation, which requires substantial resources, and
 - Adopting a more conservative “wait and watch” attitude.
- This balance must be constantly shifted between these extremes as situation changes. Erring too far in the direction of deciding “quickly” can be costly, while “wait and watch” is an error that can be particularly catastrophic (\$).

UNCERTAINTIES IN ELEMENT OF *ACTION* *PLANNING AND ACTION SCHEDULING-1*

- Supervisory control also involves the optimum planning of actions (selecting flexible information decision) and the scheduling of their efficient execution.
- Many factors significant in planning and adapting optimum action sequences include:
 - Preconditions necessary to carry out actions,
 - Constraints proposed on actions,
 - Side effects of the proposed actions,
 - Rapidity and ease of implementing the actions,

UNCERTAINTIES IN ELEMENT OF *ACTION* *PLANNING AND ACTION SCHEDULING-1*

- Certainty of success of the actions,
- Reversibility of the action and the “cost of being wrong”,
- Cost of action in terms of information origination and of resources,
- Here two approaches are possible:
 - To carry out simulation of actions to determine whether there are hidden flaws, or
 - Execute actions incrementally, dynamically changing plans as decision process goes along.

UNCERTAINTIES IN ELEMENT OF *ACTION PLANNING AND ACTION SCHEDULING-2*

- Uncertainties present in this element are in terms of:
 - Sub-optimal action planning (\$),
 - Failure due to poor choices for the set of actions to be performed or due to attempting to perform actions that are incompatible with each other (\$).

UNCERTAINTIES IN ELEMENT OF ACTION

PLANNING AND ACTION SCHEDULING-3

- Concern of the decision making process is not only to decide flexible information decision but also to physically implement the information decision.
- When performing actions, a variety of errors of execution (slips) (\$), may occur.
- Risks due to slips could be addressed through engineering safety devices.

UNCERTAINTIES IN REEVALUATION

ELEMENT-1

- Successful dynamic decision making in complex and rapidly changing situation requires the supervisory control level to initiate frequent reevaluation of the situation either because of the I*I risk experienced by the decision making process or because of the detection of the sub-optimal information decision *use* due to the unresolved I*I risk.
- Concretely reevaluation may be required because of **information errors** of:
 - The initial diagnosis and situation assessment can be incorrect, especially when the available cues do not precisely identify a problem.
 - Even actions that are appropriate for the problem are not always successful, and they sometimes cause serious side effects.
 - Furthermore, there is often more than one problem to deal with at a time.

UNCERTAINTIES IN REEVALUATION

ELEMENT-2

- Only by frequently reassessing the situation (feedback information) can the problem solving adapt to dynamically changing circumstances. The reevaluation element returns the decision making process to the “observation” element, but with specific directions or uncertainties (questions, assessments):
 - Did the actions flexible information decision) have effect?
 - Is the problem getting better, or is it getting worse? Is the goal being achieved or not?
 - Are there any side effects of the actions?
 - Are there any additional problems that were missed before?

UNCERTAINTIES IN REEVALUATION

ELEMENT-3

- The process of continually updating the situation assessment and of monitoring the efficacy of chosen actions is termed *situation awareness*, a concept that has been used extensively in aviation.
- Faulty reevaluation, inadequate plan adaptation, or loss of situation awareness (\$) results in a type of information error termed a “fixation error”. There are three main types of fixation error (\$):
 - *This And Only This*. The persistent failure to revise a diagnosis or plan despite plentiful evidence to the contrary.

UNCERTAINTIES IN REEVALUATION

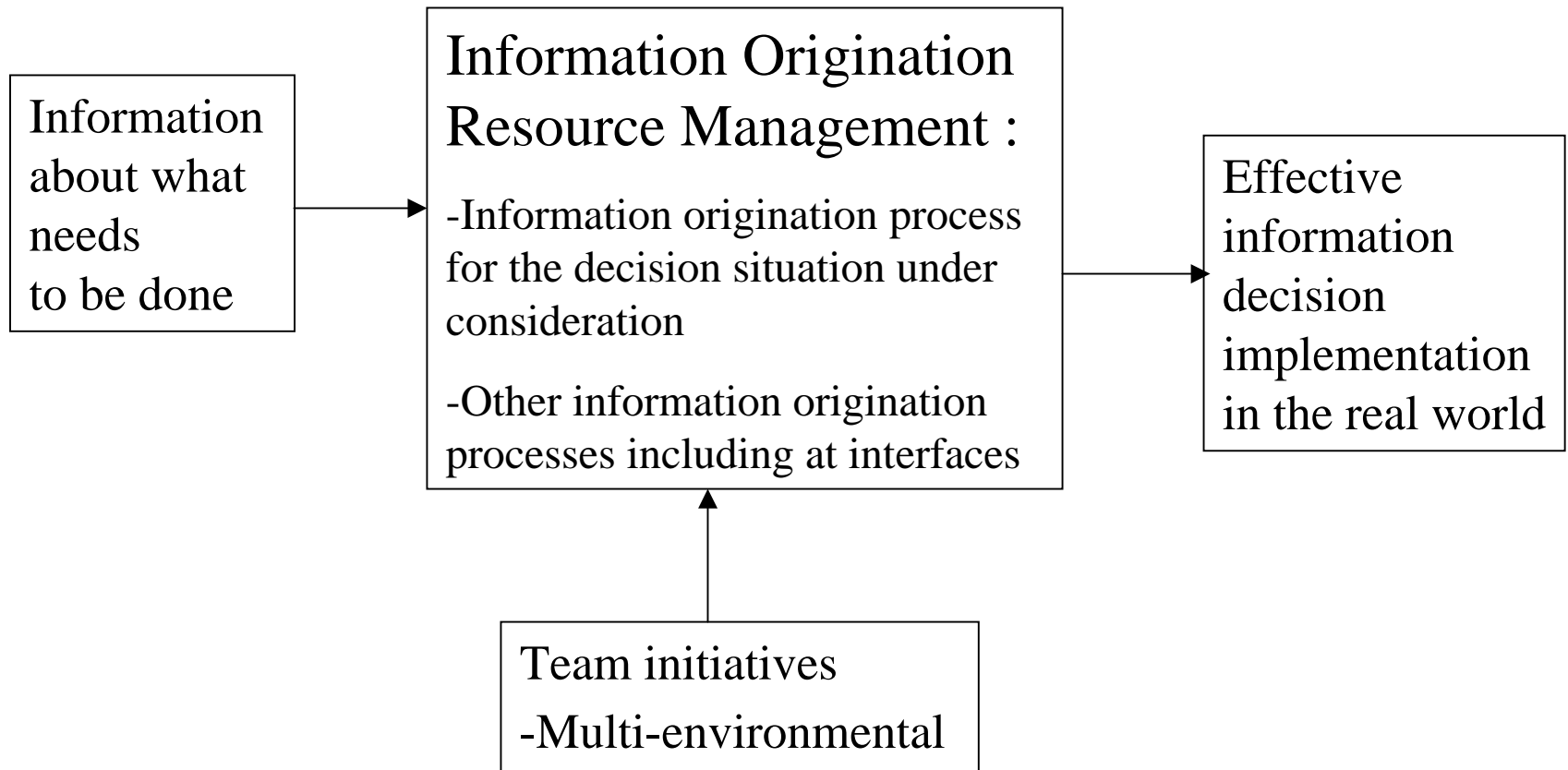
ELEMENT-4

- *Everything But This*. The persistent failure to commit to the definitive treatment of a major problem.
- *Everything's OK*. The persistent belief that no problem is occurring in spite of plentiful evidence that it is.

UNCERTAINTIES IN RESOURCE MANAGEMENT ELEMENT-1

- The elements of the dynamic decision process considered so far correspond to the activities of the *one* information origination process.
- This final element, which is at the resource management level, describes the decision making process requirement to command and control *all* the available (information origination) resources.
- This commanding and controlling of *all* the resources at hand is, in essence, the ability of the *IS* in the form of an information origination process, which the decision making process is, to translate the knowledge or information of what needs to be done into effective activity in the real world.

UNCERTAINTIES IN RESOURCE MANAGEMENT ELEMENT-2



UNCERTAINTIES IN RESOURCE MANAGEMENT ELEMENT-3

- The resources available for problem solving (i.e., to the decision making process) include the information origination process that the decision process is and other information origination processes corresponding to the objects, other people, norms, rules, commands, policies, financial mechanisms, etc. from the real world.
- Managing the information origination process of the problem solving process, i.e., the decision making process under consideration is the main concern of the supervisory control. But managing information origination processes corresponding to the other real world resources (mentioned above) requires further informational (supervisory) controls. These controls are in respect of interaction (interfaces) with elements of information origination processes of other real world resources.

UNCERTAINTIES IN RESOURCE MANAGEMENT ELEMENT-4

- Managing information origination at the interfaces with other real world resources calls for team initiatives.
- In its informational context a team is defined as “a distinguishable set of two or more real world components, which interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, which have each been assigned specific roles or functions to perform, and which have a limited life-span of membership.”

UNCERTAINTIES IN **RESOURCE** **MANAGEMENT** ELEMENT-5

- A team is distinct from a group in that a group is typically an ad hoc collection of elements without a specific mission and without specific roles. Further, the degree to which the various components (elements) of a team agree on common objectives is debatable. Clearly, all agree that a good outcome for the customer/recipient is the ultimate goal. However, there is invariably considerable informational requirements' mismatching as each team component can have individual goal, norms, policy and procedures (\$).

UNCERTAINTIES IN **RESOURCE MANAGEMENT ELEMENT-6**

- There has been little investigation of effectiveness and economy in information processing in a team defined in an informational context. Hallmark of resource management visualized for this purpose are:
 - Prioritization of tasks,
 - Distribution of informational workload,
 - Monitoring and cross-checking; utilization of all available data and information,

UNCERTAINTIES IN RESOURCE MANAGEMENT ELEMENT-7

- I*I control,
- Communication,
- Mobilization and use of all available resources.
- All this leads to development and implementation of integrity information systems.
- Literature reports that uncertainties at the level of resource management element are due to:
 - Poor information processing,
 - Poor workload management,
 - Fixation errors,
 - Poor I*I.

SUMMARY-1

- In Lecture # 18, we studied open system view of the business process *IS* in the presence of uncertainty. Further, given the complex and ever changing system environment, it was recognized that this *IS* view comprised multiple decision stages.
- Lecture # 19 further elaborated upon this *IS* view by giving system's representations of information bases corresponding to each decision stage. For the type of information characterizing it, each information base appropriately cognized it's environment.
 - It is due to the absence of this cognizing that information errors occur in information bases.

SUMMARY-2

- Lecture # 19 also considered the question of what causes the absence of cognizing about environment and leads to information errors. It was seen that these information errors are caused by uncertainties, which impact the information systems originating the information bases.
- Accordingly, Lecture # 19 gave system's representations of information base origination processes in the presence of uncertainties.
- In Lecture # 20, we studied thus emerging business process *IS* view in the presence of uncertainty along with its integrity implications.

SUMMARY-3

- In Lecture # 21, we saw that this business process *IS* view in fact processes maximal (i.e., normative as well as factual) information with uncertainty, and that it (maximal information) is described by an information envelope.
- The lecture detailed uncertainties at each of the information bases comprising the envelope. Thus Lecture # 21 gave descriptive statements of the uncertainties identified under the systems representations of the information bases studied in Lecture # 19.

SUMMARY- 4

- It is against the backdrop of the contents of Lectures # 18-21, the current Lecture # 22 recognized that, like the business process *IS* view, each of the decision stages comprising it (the *IS* view) is also a continuous information origination process.
- Thus, the current lecture argued that, given the complex and ever changing real world environment, the business process *IS* view and each of the decision stages comprising it are a series and parallel network of a core information system (a core *IS*), which is an information origination process.

SUMMARY-5

- In order to mitigate effects of business process errors, which are business process *IS* view errors, which in turn are caused by decision stage errors in the process of cognizing environment, i.e., by informational errors, this brought in the question of core *IS* errors, i.e., information origination process errors.
- Within this framework the current Lecture # 22 studied the nature of information origination process to recognize it to comprise individual elements: from “observation” to “information origination resource management”.

SUMMARY-6

- Specifically the lecture argued that each of the element of the core *IS*, which is an information origination process, has its own environment. In dealing with it (environment), information processing under each element (which requires further information origination) gives rise to information errors of own kind. These information errors are caused by uncertainties corresponding the element.
- Lecture # 22 detailed these information errors in the elements caused by the uncertainties.

THANK YOU