

Uncertainty in Traditional Business Process, which is characterized by A Collective Decision-Making

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Traditional Business Enterprise

- Seeking to produce only **‘standard’ product in high volumes**
- Characterized by control systems tuned to **‘fixed data/information decisions’**
- Strategic advantage sought by emphasizing **business objectives of operational optimization and cost efficiency**
- Carries computerized **information systems (IS) developed in isolation**; e.g., even if decision in product mix would certainly affect inventory investment, the production control application and inventory control application did not communicate with each other, the management emphasis being on integration minimization
- Requirement of business, therefore, in terms of **automation of functions of ‘hard’ components**, i.e., of ‘mechanical’ or ‘physical’ work wherein physical variables or rather material is transformed or processed or converted so as to add value to the product produced
- In other words, there is **no effort to optimize data or information for improved decision making.**

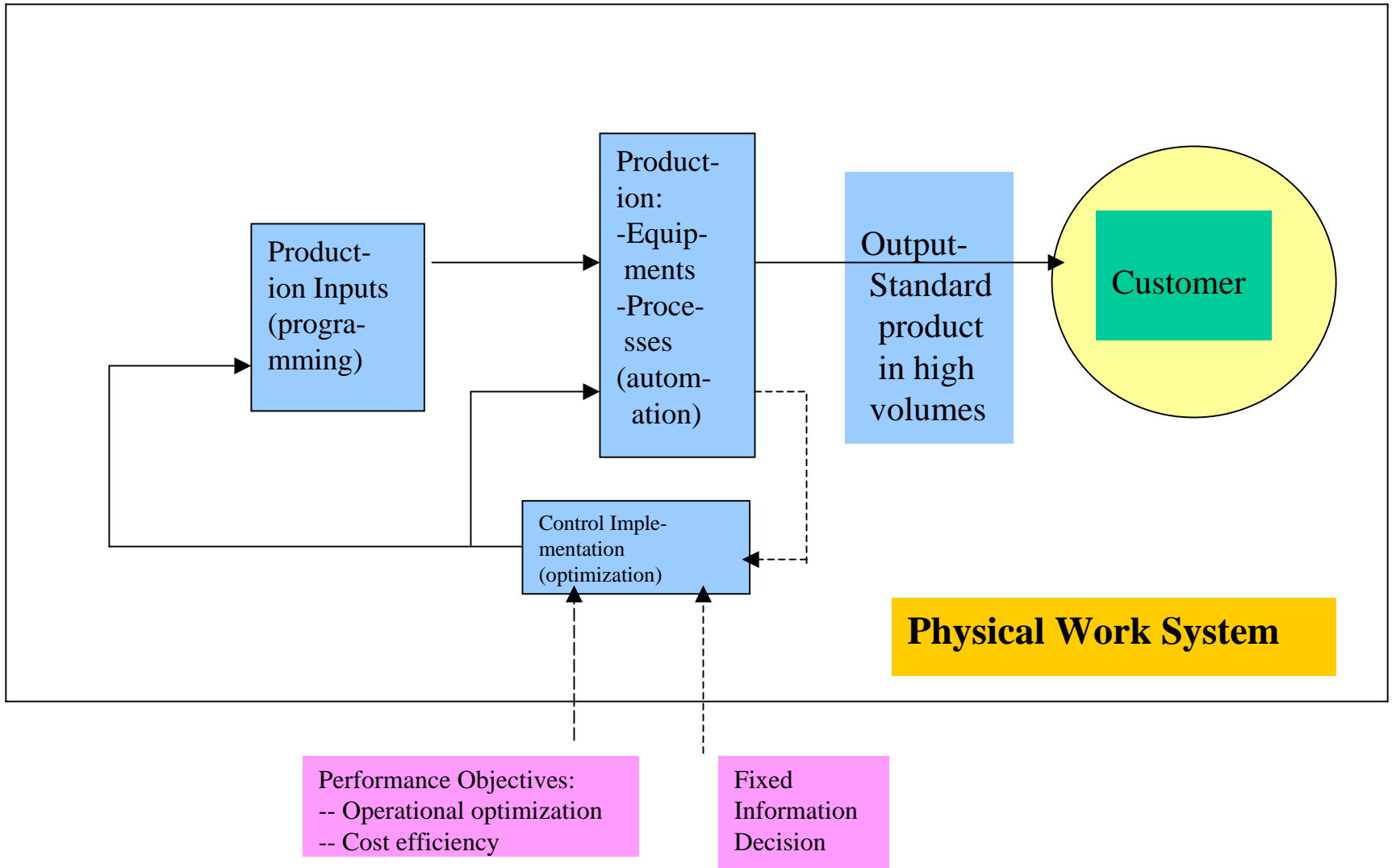
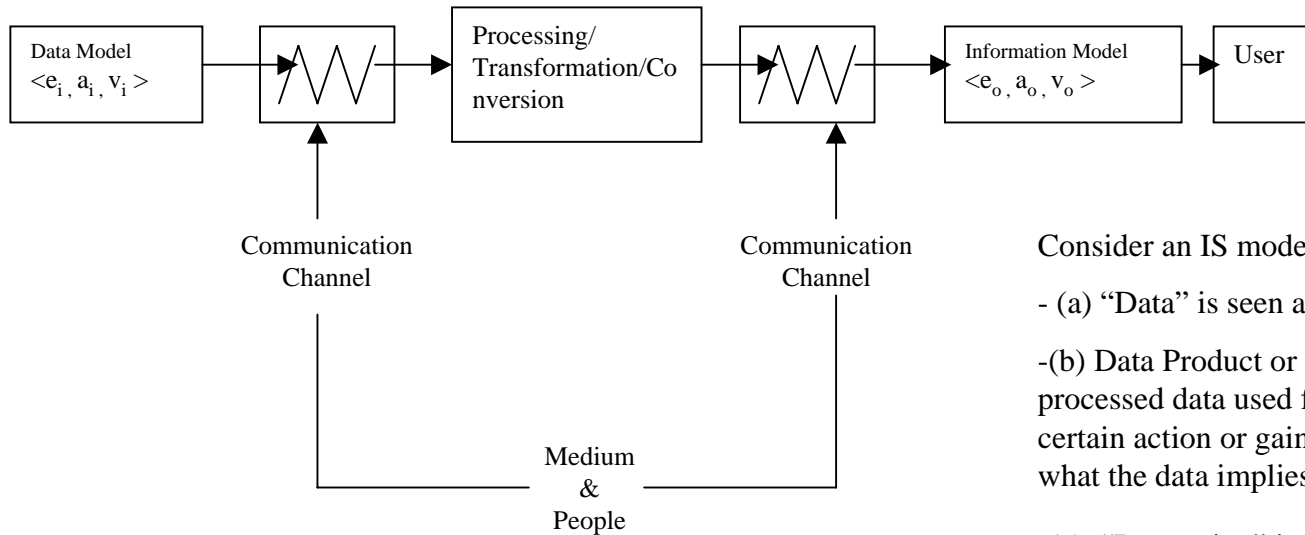


Figure: Systems representation of an automated production system producing "standard" product in high volumes



Consider an IS model where:

- (a) “Data” is seen as raw material,
- (b) Data Product or “Information” is processed data used for a decision to trigger certain action or gain better understanding of what the data implies,
- (c) “Processing” is system function,
- (d) Data/Information model is represented by triple $\langle \text{entity, attribute, value} \rangle$,
- (e) Computing process includes microcomputers and telecommunication, and
- (f) Communication channels comprising data communication and particularly transaction processing network with world wide reach, are components of the IS system.

Figure: Conceptual Presentation of IS Model

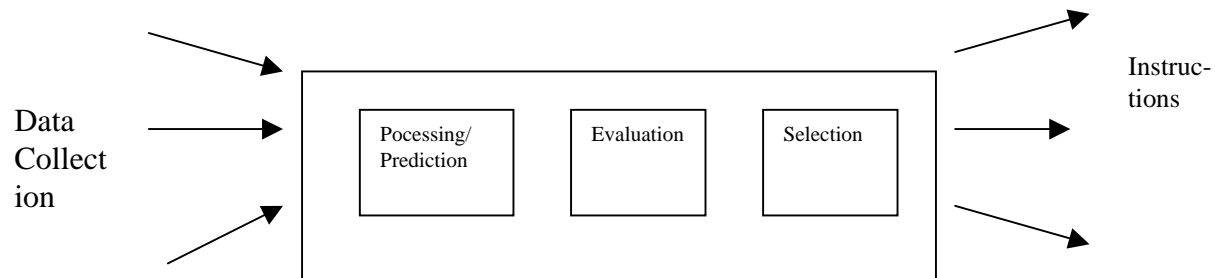


Fig.: Decision Process Model representing information movement which is at the core of an informational work carried out by an *IS*

Uncertainty in A Collective Decision process

Business Environment Uncertainty and its implications on IS

- This business process IS view is subjected to **errors in data & information** processed.
- Specifically, these errors are caused by business **system environmental factors external to the IS application system and overlapping the user environment** ('user ' includes designer, operator and direct functional user of IS).
- These **system environmental factors** are: Change, Complexity Communication, Conversion, and Corruption (5 Cs).
- **Change** factor pertains to the difference in the state of a system between two points of time.
- Every new component, be it hard or soft, adds new interface in the system of business enterprise, and therefore new variables in the system and increases **complexity**.
- **Communication** stands for movement of data/information within or across enterprise.
- **Conversion** factor refers to the consolidation, decomposition or transformation of data.
- **Corruption** factor relates to human behavior (poor motivation, desire for personal gain, carelessness, actions of people) and to unpredictability (noise) of any kind.

Uncertainty Implications of **Change** factor

In the face of Change , various factors introduce uncertainty in the understanding of the business developmental processes and, as a result, introduce errors in business IS implementation leading to data and information processed by IS being rendered inaccurate, incomplete and unreliable. **These factors are:**

- (i) **dynamics inherent in the system**, thus making reality to some degree active,
- (ii) possibility of **incomplete view of system state**,
- (iii) **inaccurate and incomplete perception of the 'reality model'**,
- (iv) **inability to know all system inputs** for all future times,
- (v) **inability due to time delays to foresee effects of particularly minor changes**, and
- (vi) **speed-accuracy trade-off** (time pressure),

Uncertainty implications of **Complexity** factor

• **In the face of Complexity, various factors, making the business operate in an environment of uncertainty, both within and beyond its boundaries, and giving rise to errors in IS leading to data and information processed being inaccurate, incomplete, inconsistent and unreliable, are:**

- (i) incomplete knowledge about system variables and structures governing their relationships,**
- (ii) variables to which, due to system non-transparency, one may not have direct access, i.e., unobservable or partially observable variables, and hence not exactly measurable (e.g., external variable like customer expectations, or internal like particular production process information),**
- (iii) judgmental situations leading to 'what if' type problem solving - involving forecasting, evaluation and selection, i.e., decision ,**
- (iv) difficulty humans have in dealing with complex systems,**

Uncertainty implications of **Communication** factor - 1

•Emerging global, distributed business structures for competitive advantage and access to bigger markets are formulating business information systems as **networked, computerized information systems**. This brings in the Communication factor.

• Specifically **in the face of Communication factor, a wide range of issues** which are error-prone, **give rise to uncertainty** in the business system environment resulting in errors in IS leading to data and information processed being inaccurate, inconsistent and unreliable. **These issues are:**

(i) **communication noise**, inherent signal interference,

(ii) **causes relating to physical structure** of telecommunication:

- electromagnetic signal radiation

- circuit switching deficiencies such as:

- cross talk between circuits,

- failure of mechanical or electronic components of the switch itself,

- interruption in electric power supply used by the switching facility

Uncertainty implications of **Communication** factor - 2

(iii) causes relating to logical aspects of data communication:

- failure of the software used in either data communication network management or in data communication itself
- software specification faults
- coding faults
- logical errors within calculations
- stack overflows or underflows
- use of un-initialized variables

(iv) size and inherent complexity of the network being used

(v) business culture on the Net which values speed over quality in software development when software errors multiply geometrically,

(vi) acts of sabotage, incidents of accidental destruction

(vii) effects of adverse weather and water caused damage

(vi) the very nature of the cognitive processes (at human - IS interfaces)

Uncertainty implications of **Conversion** factor - 1

- **Whenever one converts data from one form to another, there exists a possibility of error introduction resulting in uncertainty** and in information which may not be accurate and reliable.
- **Specifically**, “conversion” factor pertains to processing function comprising machine operation, use of data files, use of systems and application programs and of processing operation itself.
 - From these, **machine operation suffers from errors caused due to:**
 - **incorrect operations due to reasons such as:**
 - **microprocessor design faults:** Modern microprocessors have become extremely complex, having perhaps several millions of gates. This in turn introduces complex, networked fault mechanisms which can not be tested at development stage by the assumption of isolated single-stuck-at faults model; thereby leaving the digital circuit operation fault-prone in that it fails to correctly implement its intended function.

Uncertainty implications of **Conversion** factor - 2

- **mistakes within the design of the physical hardware, or within the implementation of its microcode** leading to processor implementation errors
Note:As a result, the problems that appear within real devices are those that are most likely to avoid detection during the testing process and during actual use.
- **errors caused by some instructions in complex microprocessors seeing very limited use and , thereby, faults going undetected** for some time
- **errors in processors due to interaction between asynchronous events**, such as interrupts and, and particular instructions
- **mistake in the design of circuit**, e.g., component or module being put under stress by requiring it to dissipate power more than it (the component or module) is designed for or a logic circuit design resulting in an incorrect input for a given combination of inputs
- **errors in the specifications** (which could manifest as hardware faults)
- **operational errors caused by random hardware component failures**

Uncertainty implications of **Conversion** factor- 3

- **errors even as, for improved maintainability, system includes built in test equipment (BITE):** BITE speeds maintenance by simplifying the task of locating faults. However, the inclusion of additional hardware (and/or software required) invariably increases the complexity of the system, and, as a result, introduces new errors.
- **errors caused due to electromagnetic incompatibility of the system** as observed through:
 - interference from an external noise source affects the operation of the system (this is most often caused by electromagnetic radiation, or by coupling through common power lines)
 - undesirable interaction between sections of the system (this may come about due to a number of mechanisms, including electric, magnetic, or electromagnetic coupling, power supply variations and ground currents)

Uncertainty implications of **Conversion** factor - 4

- error implications of lack of electromagnetic compatibility (EMC) in a component/module/system can never be overstated. Component or system that generates excessive interference could affect the operation of nearby hardware. Further, good EMC performance cannot be achieved simply by good design. The best design could be compromised and errors can be caused as a result of:

- incorrect assembly of a component using plastic rather than metal washers
- painting or plating a bonding surface before assembly
- incorrect procurement or storage of components
- incorrect assembly of gaskets
- changes of components during maintenance

Note: From the above examples it is clear that all aspects of design, development, manufacture and maintenance can introduce error in machine operation

- **fraudulent operation**
- **processing not on time**
- **machine breakdown**

Uncertainty implications of **Conversion** factor - 5

-Data file errors are caused due to:

- poor physical storage
- lack of clearly defined responsibilities for data files
- inadequate procedures
- natural disasters and theft, fraud or sabotage, etc.

- Errors during the use of systems and applications software are due to:

- software specification faults: specification
 - incorrect, incomplete, inconsistent, ambiguous
- coding faults
- out of sequence programming
- wrong programming instructions
- wrong algorithms

Uncertainty implications of **Conversion** factor - 6

- logical errors within calculations
- stack overflows and underflows
- use of un-initialized variables
- poor documentation
- lax security
- **Errors caused at processing stage** are due to:
 - carelessness in data processing
- **Errors at human-IS interfaces** at various levels of IS

Uncertainty implications of **Corruption** factor - 1

- Information system development life cycle includes humans in the form of designer, developer, operator, user, etc; in turn introducing human-IS interfaces at various levels.
- These human-IS interfaces are prone to errors due to factors judgemental in nature.
- Specifically, even if all the design problems at the level of physical ergonomics were to be solved, even if the best possible equipment were to be available, at the human-IS interfaces slips, mistakes and violations will occur. The major psychological factors that affect the probability of errors are:
 - (a) humans tend to avoid reasoning their way to solutions, and prefer to pattern match,
 - (b) when uncertainty in information and as to what action to take, humans will choose one that has worked before, and more often they have successfully used a particular actin, the more likely they are to choose it,

Uncertainty implications of **Corruption** factor - 2

(c) inability to think in terms of nonlinear networks of causation and to understand exponential development,

(d) human cognition (conscious), the very “tool” needed to deal with uncertainties and unknown realities, functions rather slowly and is not capable of processing many different information variables at the same time (this slowness coupled with convenience of flexibility and desire to prove greater competence (particularly under time pressure) prompts shortcuts (in the form of violations) to save on time and scarce thought energy, and

(d) tendency under time pressure to apply overdose of established measures.

- In the face of Corruption factor, for the above reasons of judgemental errors in the human information processing, the business information environment becomes characterized by uncertainty giving rise to errors in IS view. .

**A Systems View of
Uncertainty in
The Collective Decision-Making,
which characterizes Traditional
Business IS**

Uncertainty in Business Process IS view and its Integrity Implications

- Due to the system environmental factors of 5 Cs [Change (C1), Complexity (C2), Communication (C3), Conversion (C4), and Corruption (C5)], this information and control system constituting business process IS view is characterized by uncertainty at various levels.
- Traditional systems, emphasizing individual production machines, exhibit the existence of uncertainty at plant operations level and first control level:
 - At plant operation level, the uncertainty is in the input (η_i), operations (η_p), and output ($\eta_{C1,2,4}$)
 - At first level of control, the uncertainties are due to measurement or observation noise (η_{ob}). Measurement error factors and uncertainty at the plant/ process operations ($\eta_{C1,2,4}$) may render information observed at plant output to be inaccurate and incomplete, i. e., affected by measurement or observation noise.

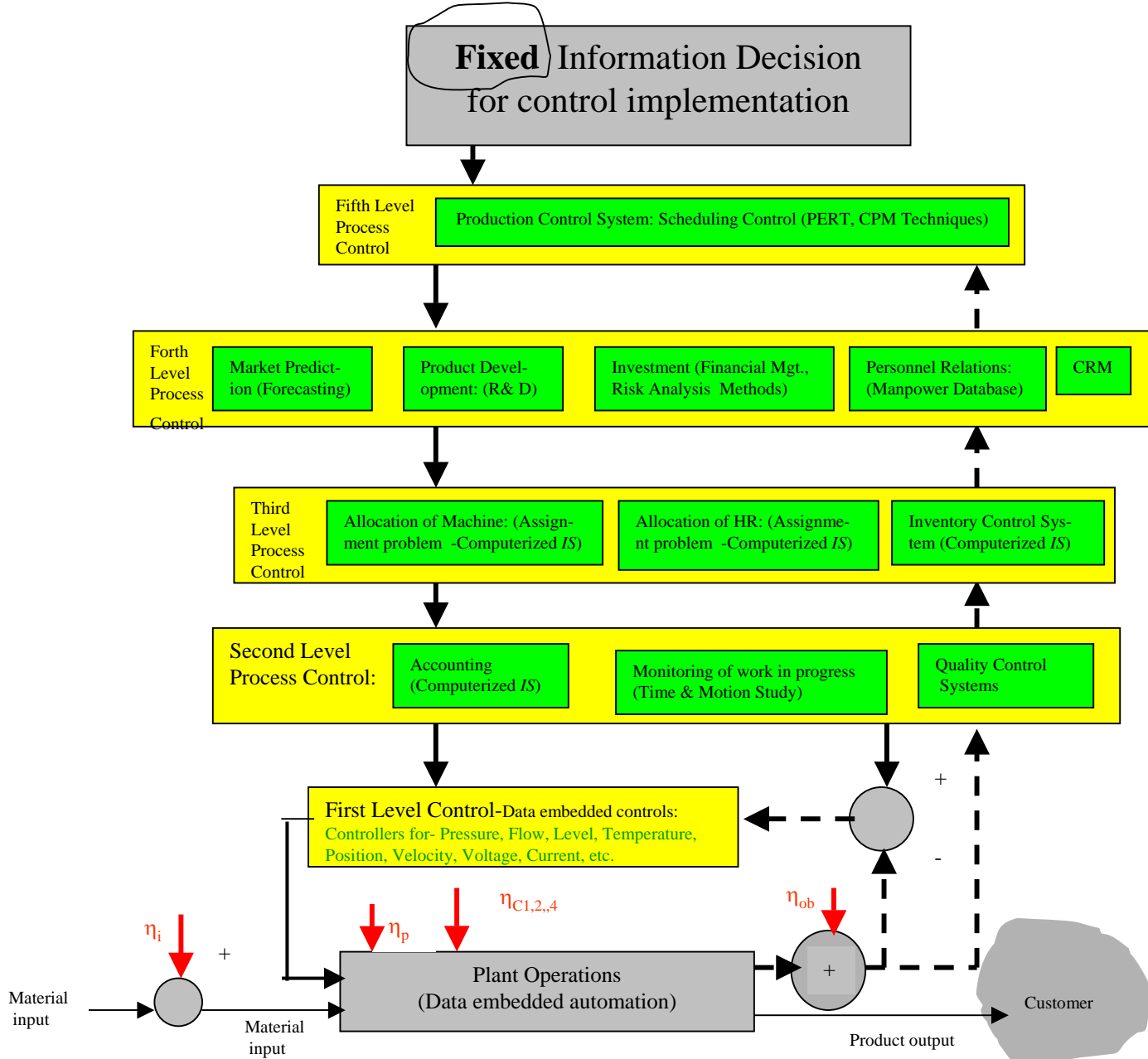


Figure: Modeling a traditional business process characterized by Uncertainty at Plant Operation level

Traditional Business IS – Uncertainty in Collective Decision Process View due to ‘application’ emphasis with system non-integration

Uncertainty types newly emerged due to ‘application’ emphasis, with system non-integration

- With the advent of computer technology, further **impetus for automation** initiatives came in the **form of higher-level process controls**.
- Specifically, these were ‘**applications**’ of computerized information systems **justified**:
 - (a) **initially on the cost reduction aspects of processing structured and periodic information**, the business work clerical in nature being the obvious choice, and
 - (b) **later as management tools for planning, direction and control**.
- Figure (2) shows different process control levels - higher than the first level control, with the feedback information from lower level control to the higher level, and the reference, i.e. feed-forward information, from higher level to lower level.
- For the reasons mentioned, businesses developed more and more of these ‘**applications**’, each with its own **terminology, procedures and data sources** giving rise to new uncertainties. Further at these higher levels, the **human-machine interface is also prevalent**. Within this framework, **following uncertainties are identified**.

Uncertainty types present at all process control levels

($\eta_{IL, LoS, IMIN, ISDILC}$)

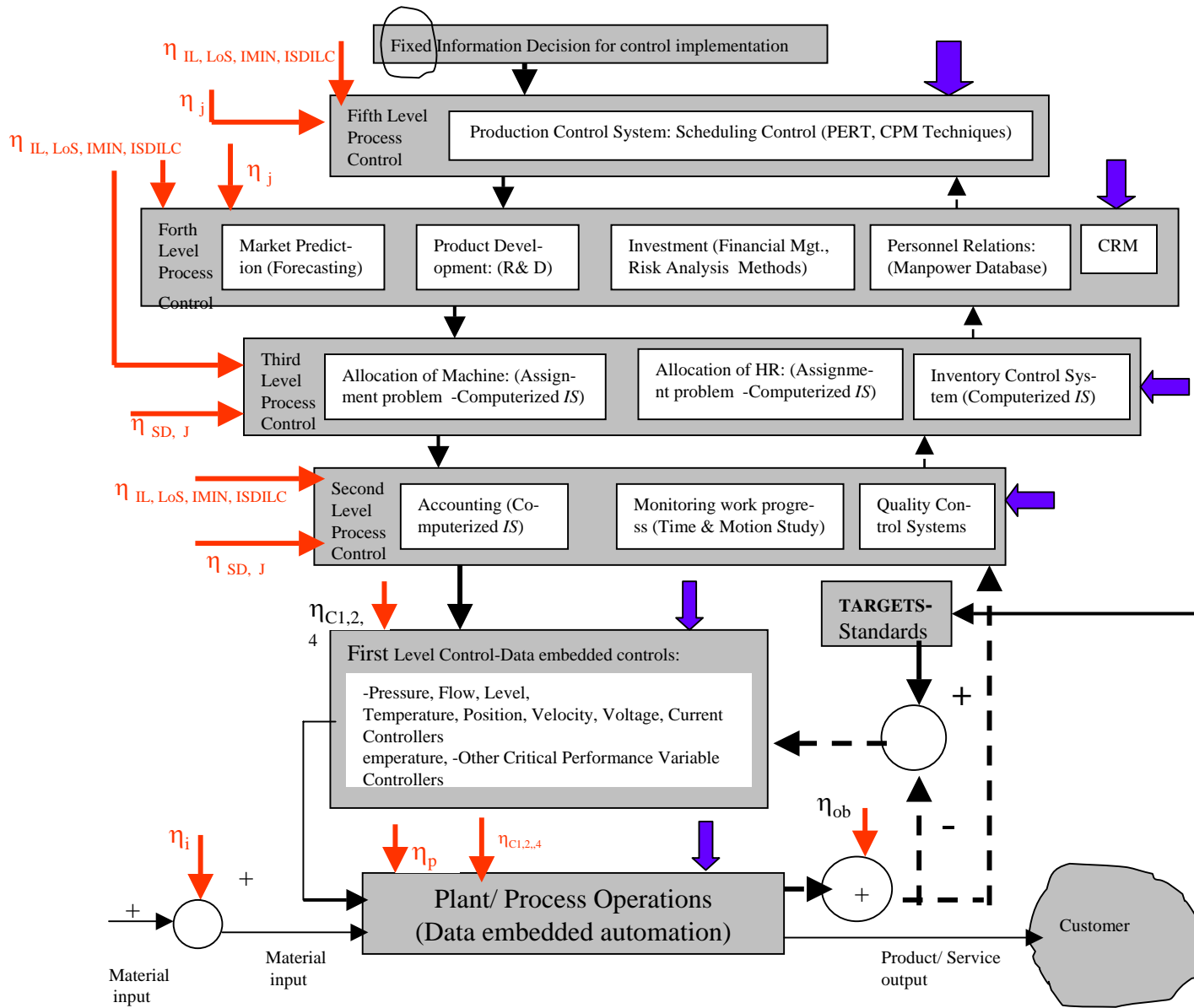
- (a) Uncertainty due to information overload (η_{IL}),
- (b) Uncertainty due to lack of standardization (η_{LoS}),
- (c) Uncertainty due to lack of relationship between the data in several applications (problems arising from emphasis on integration minimization) (η_{IMIN}),
- (d) Uncertainty due to errors in hardware, software, data entry, or accidental or intentional failures (including human failures, etc.), i.e., uncertainty due to errors in information system development and implementation life cycle (η_{ISDILC}).

Uncertainty types at process control levels 2 & 3

- These control levels deal with managerial decisions at middle level [Figure (2)].
- These levels are *also* characterized by uncertainty due to:
 - incomplete knowledge of system dynamics (η_{SD}) and
 - due to judgmental errors at human-IS interface (η_j)
- Levels characterized in much more rudimentary and uncertain way by the **deterministic and stochastic models of linear and non-linear programming decisions** as against the plant/process and first-level controls that can be fully described by deterministic model.

Uncertainty types at process control levels 4 & 5

- Deal with higher management level decisions:
 - Market predictions [forecasting],
 - Product development [R&D],
 - Investments [financial management, risk analysis],
 - Personnel relations [Manpower database], CRM;
 - Production control system, Scheduling control) .
- Characterized by human-machine systems in which humans start playing dominant part in decision making.
 - Particularly, the process controls at level 4 are often described by decision theory models, while process control level 5 which may comprise production and scheduling controls (planning control included) differs from conventional control in that it includes humans as part of the process to be controlled. All this adds to uncertainty at process control levels 4 and 5 (η_j).



- Legend:
- Change (C1)
 - Complexity (C2)
 - Communication (C3)
 - Conversion (C4)
 - Corruption (C5)

Figure: Traditional Business Process Model with “application” emphasis and system non-integration and characterized by uncertainty and its Information Integrity Implications.

THANK YOU