Developing a business flight simulator for learning organisations

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Abstract

The Business Flight Simulator is a major action research project involving academic and industrial collaborators. Its central purpose is to support the creation and development of learning organisations through the application of a wide variety of IT and software tools. The particular influence of evolving systems dynamics thinking on the project is identified. The project also draws on findings from a recent international study of the application of information technology to support group working. The preoccupation of the Business Flight Simulator is with creating a physical and networking environment for group decisions and their implementation. Groups are supported by a variety of software tools. Much of the emphasis during the last decade has been on the application of single tools to support groups, or of tools with constrained functionality. The Business Flight Simulator, by contrast, draws on a wide menu of tools to support group working. These range from the highly quantitative to those which focus on more qualitative and inter-personal issues. The research project involves applying combinations of tools to business processes across a variety of industrial sectors, and preliminary conclusions in this area will be discussed.

The Concept Of Waste and Its Use in Information System Design

Introduction

Information system designers tend to use a very simplified model of the system to be produced, ie

INPUT ----> PROCESS ----> OUTPUT
(Data) (Process) (Information)

This lacks not only the cybernetic element of feedback but also makes no allowance for the fact that no system is 100% efficient. To make allowance for this lack of complete efficiency the model should be expanded to:

INPUT ----> PROCESS ----> OUTPUT + WASTE

The I-P-O model used by designers makes them concentrate on input data, the process logic and the information output. It assumes that all of the input data is converted to information. Information here is defined as something which causes a change in the user's knowledge base. Hence, if the data being processed does not add to the user's knowledge, it does not produce information. In this sense, how many "information" systems are really "data" systems, ie data in and data (waste) out?

When the inputs are expanded to include such things as people's time, money, and equipment, the presence of waste in the system becomes more apparent. In a system consisting of mostly physical components, eg a chemical processing plant, the inputs, outputs and waste can easily be identified and measured by such things as heat and waste products. Because they can be identified, attempts can be made to minimise them. In manufacturing situations, Total Quality Management and Just In Time philosophies emphasise waste minimisation. Waste is, however, much more difficult to identify in information systems and is rarely considered by designers.

Holistic thinking can greatly reduce waste. Concrete examples include power stations who use their warm water "waste" for aquaculture, or, who make their generation less efficient so the waste warm water becomes hot and is used to heat surrounding dwellings. Information systems designers also need to integrate systems creatively and not treat each system as a separate entity.

What is waste?

There are many definitions of waste. It can be '*any activity that adds to the cost but not to the value of a product*' [Maskell, 1989], or, '*anything other than the minimum amount of equipment, materials, parts, space, and worker's time, which are absolutely essential to add value to the product*' [Chase & Aquilano, 1992]. Sushil [1990] gives a much broader definition: '*Waste is any unnecessary input to, or any output from any system*'. The system model can therefore be expanded to include the possibility of waste being input to the system as well:

INPUT + [WASTE] ----> PROCESS ----> OUTPUT + WASTE

The input waste can, theoretically, be eliminated by good design. The output waste can, however, only be minimised (as no system is totally efficient).

Sushil further defines the WASTIVITY of a system as being:

$$\text{WASTIVITY} = \frac{\text{WASTE} \quad \text{(Unwanted system outputs)}}{\text{INPUTS} \quad \text{(Resources used by the system)}}$$

Wastivity's relationship with productivity can be defined as:

$$\text{PRODUCTIVITY} = 1 - \text{WASTIVITY}$$

In an organisational context, unwanted system inputs and outputs can come in many forms: excessive staff numbers, shortage of staff, absenteeism, lack of worker skills, under-employment, overproduction product defects, waiting time, redundant information output (ie low quality information or no information at all according to the previous definition unless it adds some knowledge to the user sense), etc.

Information systems designers tend to concentrate on data and information as inputs and outputs Although there can be waste here, the impact of a new information system can have waste implications far from this narrow perspective of what the system will actually consist of.

The problem definition stage

Many designers now recognise the importance of including all the pertinent views within the organisation at an early stage in the definition of the required system. Checkland's Soft Systems Methodology - SSM - (see Checkland, 1984, Checkland & Scholes, 1991 and Wilson, 1990) is popular for this approach. If SSM is used, the concept of waste can be utilised by the facilitator to highlight the paradigms, biases and priorities of the stakeholders. One person's waste can be another's benefit. SSM uses "Rich" Pictures to set the scene and the inclusion of waste at this stage can be very illuminating Exposing the negative side can show up differing fears, prejudices and perceptions of the stakeholders regarding the present or a proposed system. Differing perspectives of the problem situation will give the designer an insight not only to the stakeholders' ideas as to the nature of what is undesirable but the extent and likelihood of the undesirable consequences of the system. Management and staff, for instance, can have totally different opinions as to the nature, extent and probability of undesirable system consequences. The definition of the ideal system (ie the Root Definition in SSM) can also include the waste that will be produced by the system. This needs to be included as there will be waste and its exposure can have a profound effect on the participants' thinking. At present, only the beneficial effects are considered and this can give an unrealistic impression of the system's desirability.

The systems analysis stage

A Cost Benefit Analysis (CBA) of the system lists out the inputs (costs) and outputs (benefits) of the new system. The other output - waste - is rarely included. As no-one deliberately includes waste in a system design, it can be politically expedient to ignore it. No system is perfect. The drawbacks of the proposed system should be exposed. If the new system has less waste than the new then this is a benefit. Because all systems have artificial boundaries drawn around them waste from one system will become an input to another. A new system might cut the need for staff for one function but can it be assumed they can be productively used elsewhere? Because waste in one system will become the input to another system, it needs to be controlled. Unless it is controlled, a good idea in the narrow context of a single system will become a bad one when a holistic view is taken. In a practical sense, it is very difficult for managers to take this holistic approach because of lines of responsibility and power limitations but an attempt needs to be made to ensure waste does not multiply through the organisation. For example, waste output from one system in the form of unneeded reports, or, memos requiring answering can soon escalate its impact around the organisation.

Information is a resource and, as such, can be wasted. Ronen & Spiegler (1991) consider over-collected, over processed and duplicated information as a waste. In fact, they go further and say that too much information may be worse than having too much. This information has to be acted upon and generates useless tasks which may not only cost the organisation money but also disrupt management decision making. In this sense, information becomes system "noise". Designers need to take this into account and not create low grade, "nuisance" information. This has become much more difficult to control as microcomputer usage has spread around organisations and has become a management rather than a design problem. The cliche that the paperless office produces more paper than a conventional one is not without foundation. Whatever a designer does, of course, can be negated by organisational inertia eg managers who insist their e-mail messages are printed out every morning.

In detailed design, the specification of particular data items rather than general ones eg Customer Details will greatly assist the reduction of unwanted data and information when the system is implemented. This ensures only the data items required are input to and output from the system. An example: 60 fields were included on one screen for a system monitoring the activity on an oil rig. The user was only interested if one of the field displays was flashing showing that a field's upper, or, lower parameter had been crossed. In a "normal" situation, a blank screen would have carried as much information as one cluttered with 60 fields ie everything was within set limits. In a situation where a parameter had been crossed then that field should have been displayed by itself. It would have attracted much more attention and would have had less unwanted data (waste) on the screen. Think of the difficulties and system noise if 10 fields started flashing on the cluttered display. In this case, waste had been created by bad human-computer interface design.

Post Implementation Review

It is essential to review the system in terms of waste once it has been implemented. Detrimental consequences should be considered as well as the benefits. These should include impacts on all facets of the organisation eg staff morale, efficient use of staff skills, impacts on other departments, etc.

This helps build up the organisation's knowledge base for further system development. Discussion of detrimental effects can be difficult in some organisational cultures because the instigators, developers and owners of the system may have too much personal involvement in it. In some situations, it is political suicide to admit there is waste. Management needs to create an environment where waste is taken as inevitable but needs to minimised. Of course, it cannot be minimised if it is not recognised.

Principles of Waste Management

Conventional waste management is primarily concerned with physical waste disposal. However, some of the principles stand out and are relevant to most situations:

1. If there is no cost to the person wasting a resource, there is no incentive to minimise this waste.

2. Disposal of waste is most efficient at source.

3. Prevention is cheaper than processing, removal, or, remedial action.

These principles imply a number of things for managers and system designers:

1 Personnel involved in any system need to have some ownership of that system, or, there is no incentive to minimise waste.

2. Managers should control waste as soon as it is identified, or, it will cost the organisation (sadly, sometimes not the individual manager) more in the long run.

3. System designers should recognise waste as a factor and attempt to minimise it in their design.

Conclusion

Waste is a cost to us all in one way or another. It is a concept which can be productively used i information system design. By definition minimising waste increases productivity. By recognising th detrimental effects of a system, the situation can be managed and perhaps the waste form one can becom a useful input to another. If it is ignored, it will multiply.

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