



<b>Paper/Article name:</b>	Systemic integrated and organisational design considerations
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<b>Overview:</b>	The paper explores the challenges related to OD, and how a complexity science areas may offer improved design parameters



## **Systemic integrated and organisational design innovations**

The management system (agents or people or employees) of an enterprise can be seen as an agent maintaining a system of objectives, having emergent properties of its collective and its environment. A key challenge to management is thus, how to facilitate and manage these emergent qualities? It is increasingly important to devise faster and more reliable ways of designing purposeful, agile organisations (Bernus *et al*, 1997).

An enterprise can be thought of as consisting of an operational and a decisional system (Doumeingts *et al*, 1998), each implemented partly by humans and partly by machines (Bernus and Nemes, 1994). In fact researcher already demonstrated conditions for the enterprise to behave as an agent, and provided insight into notions such as fractal factory, holonic manufacturing, and others (Bernus and Nemes, 1999).

## **Organisations, as/and agents**

In this context, two vital organisational design issues are – (1) how to design the task structure of the organisation, in order to form a co-ordinated whole; and (2) what human tasks ensure the organisation will satisfy its objectives? An organisation should conduct a system of activities managed and controlled to satisfy a set of organisational objectives. This requires purposeful behaviour so that the organisation can be characterised as a planning agency having many planning agents.

*A planning agent/agency determines a course of action to achieve its set of objectives. This course of action, or plan, is constrained by the agencies resources as well as its*



individual agent's own functional capabilities. The organisation follows, or appears to be

following this plan while monitoring the effectiveness of the actions to actually satisfy the objectives for which the plan was made. If the plan fails in some way, then the plan or the objectives are modified.

Such system of objectives could be related to external relationships (customer demands, returns on investments, etc), or internal ones (efficiency, integration, etc). The *operation* of the organisation has an interface to the outside world through which consumed and produced material and information services can flow while the *management and control* system has an information interface to the outside world. The management system almost always has a set of constrained objectives:

- ⌚ The information flow between the organisation and the outside world *partially determines* what objectives are worth following (e.g., what are current needs, etc). Capabilities of the management and control system *limit* the ability of the organisation to commit to certain objectives, even if operational resources are otherwise present;
- ⌚ The material and information interfaces *limit* what is accessible for the organisation's resources and *determine* the feasibility of actual operations as opposed to potential ones;
- ⌚ Capabilities of the operational resources (competencies) also form a *natural limit* to the organisation's feasible objectives.



## **Autonomy and authority**

Generally, the mechanism or resource assigned to management and control in organisations, is the same agent, which performs the operations. This is typical of biological systems (e.g., organisms) and reflects the organisation's ability to retain autonomy, i.e., operating and controlling itself at the same time. Also the organisation has the authority to commit its resources to objectives.

Thus, further to this, an autonomous individual or agent must co-ordinate its objectives and actions with other agents, and it must co-ordinate its own actions to satisfy its objectives under the negotiated conditions, inferring a capacity of an agent, to plan and control. The internal co-ordination tasks are interrelated with the external ones, which also suggest agents may relinquish some autonomy to achieve objectives otherwise outside of its reach, e.g., a contingent strategy to act together may be agreed on, with the condition to find agreeable tactics, in turn contingent upon agreeable plans, etc. These negotiated protocols, allow agents to determine future joint action, and act on it.

## **The emerging agent phenomena**

Organisation (social) systems, do not necessarily display the property of agent-hood, i.e., it is not always true that joint action by agents necessarily satisfy some overall objective, nor that such action cannot lead to some undesirable state. This point reinforces the aim of enterprise integration, of build enterprises that do behave as agents, which consequently have us review and analyse the conditions under which



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agent behaviour does emerge from joint action of agents.

Another issues to consider, is fundamental requirements to achieve harmony between objectives of individual agents and those of the organisation, i.e., the *Harmony of Objectives*. Key is the decisional (management and control) roles in an organisation, and as evidence suggest, control cannot be passed unguarded from management agent “A” to operational agent “X” but through agent' X's autonomous control, which continuously compete with other requests to X. A's request “ say request number 15”, thus becomes *one* of the objectives of agent X, and it is executed because of previous commitment by A to grant such request (technically thus in competition to our requests made to X. The objectives in A's decision framework must be such that a negotiated request, “request no.15) is either granted, or appropriate corrective action is taken. Therefore, each role of an agent is really a “negotiated commitment” to perform in future any action that the role requires.

### **Consistency of decision frameworks and their allocation to agents**

An important aspect to the above is an additional consideration of consistency required when roles are allocated to agents. Typically some of these may be:

**Functional adequacy:** where the agent must have the abilities to perform the functions necessary.

**Role conflicts:** avoid conflicts among roles played by agents, especially when their plans are contingent on one another (Bernus and Uppington, 1998).



**Shared value-systems, priorities, policies and business rules:** as tasks compete for the agent's resources the agent must resolve the competition of objectives through

applying priorities, policies or values. These must be shared such that agent decisions are accepted by others, as valid and justified, hence a shared value system and policy framework is a necessary condition of negotiation and correct interpretation of commitments.

**Adequate level of autonomy:** the performance of each step of a task or the entire task as a whole, do not need detailed definition of the task. Unnecessarily detailed control limit the agent's ability innovate and optimise the resource usage. Intrusive control (lack of autonomy) has the potential to stop the agent from co-operating because its own priorities negate the needlessly prescribed practices.

These criteria extend to *all* elements influencing agent behaviour (i.e. personal, social, psychological determinants), and such organisational structures must be devised allowing these hidden elements to “emerge”. Organisational design becomes a means of indirect control because it determines the *channels* of decision-making. The organisation responds by actions (to achieve set objectives) and provides feedback for management, closing the control loop. Generally, when management realise that the class of objectives for which the present organisational design was suitable, have a less-than-desired or optimal business-coverage, they send the enterprise through regular re-engineering or re-organisation exercises. Where the design by management is always short-lived the environment is *perceived* as turbulent - although turbulence is not a property of the environment alone, but of the relationship between the environment and the organisation.

The dynamic organisation structure is a configuration of agents *designed, built and*



*operated by the involved agents* for a given class of objectives using explicit negotiated commitments and not operating based on a status quo. Individual agents build mutual

commitment, and abide by established co-ordination and co-operation rules instead of rigidly segregating the authority to design the organisation from operational tasks. Such structures are highly sought after due to their adaptive qualities, but generally require strong leadership and a sense of “maturity” of systems knowledge. Both static and dynamic organisations are built for a purpose, but their agility is *different* (static organisations preserve the current state, whereas a dynamic organisation releases purpose-based commitments when the mission is completed). Three key requirements for dynamic organisations are:

- ⌚ To have commonly available *proven reference models* of dynamic organisations and commonly accepted *co-ordination protocols* that can be adhered to in order to form temporary mutual commitments;
  
- ⌚ The agents in the organisation must develop a *working knowledge* of these models and protocols, to enable them to dynamically build the organisation themselves (institutional memory);
  
- ⌚ Have *responsibility structures* to ensure that lost management functions are substituted to retain control of the organisation;

Several experiments showed the success of this principle, e.g. developed countries where worker commitment, shared values, and unwritten policies are common. The



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socio-technical experiments in Nordic countries (van Houten, 1990, Gibson, 1973). Recent designs having flavors of agent-based integration include holonic manufacturing, and the fractal factory (Tharumarajah *et al*, 1996).

The matrix organisation was proposed with the aim of separating the rigid functional structure of traditional organisations from task-specific to a more dynamic behaviour. Typically, each individual in matrix structures, at any one point belongs to a functional entity and to one or more projects. However, in instances where allocation of tasks is based on authoritative management (mimicking a static organisation), the advantage of the matrix structure does not materialise (Evans, 1982). This view is echoed in failures of workflow system implementations as well (Klein, 1996).

Project organisations are designed for a specific task (meaning a programme or project). The project organisation does not typically remain within the boundaries of a parent organisation's management (Projects in the matrix organisation are a special case of project organisation). Typically, vendors or contractors establish a project through negotiating with sub-contractors (e.g. in the built and engineering environment). Where the major activity of the engineering company is to identify, create and support project enterprises, based on multiple levels of contracts. Since failure can be disastrous in such operations, the establishment of a high level trust in the task allocation is vital, and as such we have a tendency of such structures (large project organisations), embedding the project upon proven abilities and capacities of individuals (Christiansen *et al.*, 1995), with longer-term capability development (institutional memory), are left to a functional part of the organisation wherein which the project is executed. Such structures this tend to be good on delivery, but speaks poorly about retaining and building internal competence.



The name Fractal factory comes from the recognition that fractals have a self-similar structure, repeating levels of recursion (Warnecke, 1993). This form of organisation is based on the fact that the complexity of organisational boundaries makes organisational design complex, error prone, and inflexible. Such design parameters seek to design models of organisational entities (cells, teams, workshops, departments, etc.) such that all of these would have the same control protocol (including negotiation and commitment), allowing simpler and more flexible operation, i.e., introducing a sense of emergent design elements. The holonic manufacturing principle (Valckenaers *et al*, 1996) is based on designs at all levels of aggregation having defined levels of autonomy, i.e., where each level be it an individual, cell, team, or department, etc., have a "shell" around them enclosing an autonomous whole (Koestler, 1989). Autonomy is defined as a relative property; meaning autonomy is the ability to perform functions in space-time confinement, leaning only on a defined or implied ubiquitous infrastructure. If such infrastructure is available for each holon then holons may be considered autonomous.

Organisational design considerations, plans and transactions should thus allow the satisfaction of the described consistency criteria of systems of objectives.

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