Applying Systems Engineering to the Organization

Joe Kasser, D.Sc., CM, CEng.
The Anticipatory Testing Corporation
POB 3419, Silver Spring, MD., 20918
E-mail jkasser@iee.org

Abstract

This paper introduces the **"*Excellence paradigm*"** a paradigm for an Information Age organization. It was developed by applying systems engineering to an organization and using technology to replace managers. The paper presents a brief overview of the ***Excellence paradigm***, how command and control is achieved, and how work is done.

THE CURRENT ORGANIZATIONAL PROBLEM

In looking for reduced costs and increased profitability, businesses have tried various approaches such as Business Process Reengineering, Participative Management, Integrated Process Teams (IPTs), with varying degrees of success and mostly failure [1]. There is also growing evidence that Total Quality Management's overall success rate is so low that for most organizations, the effort was entirely wasted [2]. These failures, when analyzed appear to be due to a defect in the structure of the organization [3]. **The problem is that today's Industrial Age organizations are based on Taylor's Scientific Management [4], and the model has started to break down when applied to Informaton Age organizations with no replacement in sight.** Consequently, the non-systematic efforts and non-integrated at improvement may have reached the point of diminishing returns. This paper presents a theory for an Information Age organization paradigm named the *"Excellence paradigm*."

THE *EXCELLENCE PARADIGM*

Management is considered as the planning, organizing, directing and controlling a **time** ordered sequence of activities (**process**) performed by **people** building a **product**. Reference [5] stated that the present style of management is the biggest producer of waste, causing huge losses whose magnitudes cannot be evaluated. Juran as quoted by [6] stated that management causes 80 to 85% of all problems. The *Excellence paradigm* eliminates this root cause of organizational problems by being based on a vision of an

organization performing the functions of management but without managers [3]. It is thus a real application of the Reengineering idea [7] because it while the basic approach was similar to Taylor's approach, it is not based on his assumptions. The *Excellence paradigm*:

- Uses technology to replace many functions currently performed by managers.
- Provides a theoretical basis for understanding why the excellent organizations reported in [8] are successful.
- Moves decisions to where the action is taking place.
- Integrates a set of elements in a holistic manner. These elements outlined below are the:

    - Structure of the organization.
    - Corporate culture
    - Quality-Index
    - Division of Labor
    - Effective task management
    - Event/product based cost accounting
    - Dynamic organization
    - Effective use of technology
    - Reward and recognition system

THE STRUCTURE OF THE ORGANIZATION

A process within an organizational environment produces a product over time. The *Excellence paradigm* uses a systems approach and considers an organization as a four dimensional system (product, process, people and time). As such, systems engineering methodologies are used to view, decompose and optimize the organization.

The environmental model, for example, shows the organization exists in a marketplace comprising suppliers and buyers. In the buyer marketplace, customers are a subset of the potential market. The cost of finding new customers is greater than the cost of servicing existing customers, so companies tend to focus on retaining existing customers. This is all right, however, customers are part of the environment. They are a subset of the population as a whole. Companies can go out of business by:

- Concentrating on satisfying existing customers without trying to attract new ones.
- The lack of an awareness of changing technologies.

For example, carburetor manufacturers may have had an excellent product, and satisfied customers, but fuel-injectors eliminated the market.

Existing customers also tend to recommend adaptive improvements to products. They may not know they need innovative ones, and only recognize them when they appear. For

example, customers did not demand telephones, electric lights, automobiles, Sony's Walkman, fuel injectors, etc. until they had been invented and marketed.

The organization consists of two major systems, namely, the:

- **Production system** - which produces the product from which the organization makes its profits. Anything in this system is a direct charge.
- **Support system** - which provides the support to the production system. Anything in this system is on overhead.

The overall structure of the organization is flat and similar to a distributed computer network. Information and products flow between the work elements that can be shown in a process flow chart. Decisions are made at the appropriate level to maximize cohesion and reduce coupling between work elements. Each bubble in the process flow chart may consist of:

- **Both process and support elements**.
- **Traditional organization elements** - managers and workers, as not everyone wants to be, or is ready to be, empowered.
- **Self directed teams** - IPTs empowered by the leadership of the organization.

Personnel from the traditional functional departments are not matrixed into projects. **The process flow chart is the organization chart.**

CORPORATE CULTURE

This is the underlying basis for excellence. It:

- Consists of the characteristics of the individual people in the organization.
- Embodys the standards, vision, values and goals of the organization (system).

The organization is self-regulating within the boundaries set by the culture. Each element has a vision of what it is supposed to do, the resources to do the job and the schedule. Command and control is based on:

- Management by objectives.
- Costing products not activities.
- Ensuring resources are available when needed.
- Making decisions at the working level.
- Using technology to:
    - communicate formally and informally.
    - monitor progress is within planned limits, using the principles of management by exception and statistical process control (SPC).

THE QUALITY INDEX

The *Quality-Index* [3] of an organization is a three-dimensional measure of the:

- Degree of conformance of the product to its requirements.
- Effectiveness of the production process.
- Effectiveness of the organization in which the process takes place.

This use of the *Quality-Index* means, for example:

- The effect of poor management may be defined in terms of "cost escalations" instead of using soft "Quality" based language.
- Activities that lower the cost of 'producing the product within specifications' improve its *Quality-Index*. These activities are defined as **Organizational Engineering**.

DIVISION OF LABOR

The division of labor is between strategic and tactical and split as:

- **Strategic** - the strategic planning, coordinating, performance measuring and "communicating the vision" functions. This work is known as '*organizational engineering*' and tends to cross process element boundaries.
- **Tactical** - production work, self directing, tactical planning; the activities within a process element.

This division provides a true dual promotion path. Promotion from process IPT to process improvement IPT is a strategic promotion path for those wishing to assume more responsibility within the organization. Technical specialists who can mentor junior personnel, serve as part time members of, and advisors and consultants to, the IPTs.

The difference between strategic and tactical depends on how the work is viewed. For example, an admiral-of-the-fleet performs strategic functions, while each ship's captain performs tactical functions. Yet, within a ship, the captain performs strategic functions and the engine room performs tactical functions.

EFFECTIVE TASK MANAGEMENT

Work in the systems organization focuses on events, products and results not on activities. Prevention is planned anticipation [9]. Organizational engineers use 'communicating the vision', management by exception, management by objectives, prevention of defects, testing, and developing and using metrics to maximize the *Quality-index* to monitor and control the work. As a result work tends to be done the right way the first time, so the cost of the process is reduced All tasks are visible in a process flow or PERT chart. The description of the tasks in a process map directly to the job descriptions of the people in the tasks. This eases writing job descriptions and

requirements for people to perform them. Any task that is not producing something measurable is questionable. The people performing each task know their customers are in the next task bubble in the chart.

In today's paradigm, much is made of the difference between products and services, and the intangibles involved in services that tend to prohibit them from being measured. Yet, from this perspective, someone or something produces the service. Therefore at some point in the value chain, a service is a product.

EVENT/PRODUCT DRIVEN COST ACCOUNTING

The work breakdown structure (WBS) allocates work elements and cost accounts as follows:

- **Work elements** to the task based on the products to be produced for specific events or milestones.
- **Cost accounts** to the WBS elements. In this way, the cost of:
  - the work performed to comply with a task requirement is recorded and can be used as a baseline to refine future cost estimates.
  - each specific product or event is known.

THE DYNAMIC ORGANIZATION

In the *Excellence paradigm*, process improvement:

- Is continuous. The organization is in a state of **dynamic equilibrium**. Improvement of quality and productivity, to be successful in any company, must be a learning process, year by year, top management leading the whole company [10].
- Is a process in itself and needs to be compliant to standards. Conceptually, upgrading a process is no different from upgrading a product release. Both, upgrade a system and must be performed in an appropriate manner (change requests (improvement suggestions), impact assessments and configuration control). Approved changes are then carried out at specific milestones. **There is no excuse for chaos while implementing changes.**
- Must be performed by a separate IPT of people working interdependently with the team who perform the process. The improvement IPT gets full disclosure and suggestions for improvement from the process team, then analyzes the information and suggestions from the system's perspective to determine the effect of the proposed improvement on all parts of the process.

There are two types of improvements: - adaptive and innovative [11]. Adaptive improvements are more readily implemented than innovative ones since they improve the current paradigm. Innovative improvements tend to introduce a new paradigm, hence tend to be resisted. Adaptive improvements, however, also lead to the point of diminishing returns. This is the point where an innovative change is the only way to

obtain any large degree of improvement. These types of changes may also be directly related to cost. Adaptive improvements reduce costs over a time, yet the rate of reduction slowly reaches the point of diminishing returns. Note that while innovative changes may be employed anywhere along the curve, **failure to innovate once the cost reduction curve flattens out tends to result in an organization going out of business.**

EFFECTIVE USE OF TECHNOLOGY

Technology has many uses, but must be applied in an integrated manner. Thus, information in a computer in one part of the organization, or in one software application must be accessible by others. This requires compliance to Industry Standards, not to manufacturers' standards. One reason, for such compliance, is in word processing. WordPerfect 5.1 for example, cannot read WordPerfect 6 files. This lack of compatibility in one producer's products requires people to upgrade just to be able to exchange data files, even if the additional features in the upgraded software are not needed or desired. There is also the problem of exchanging files between programs produced by different manufacturers (e.g., Word and WordPerfect).

Technology must be used in a seamless and almost invisible manner. For example, forms should be front ends into databases and used for data entry and retrieval. However, technology should only be used where it is cost effective. A flow chart template, and paper and pencil may still be more cost effective than software in documenting processes in your situation.

REWARD AND RECOGNITION SYSTEM

The organization's reward and recognition system (RRS) must reinforce behavior that is in accordance with the values of the organization. [12]. People's behavior is explained several theories including [13] which postulates two opposing types of behavior (Theory X and Theory Y). The difficulty in reconciling the two types of behavior may be because they are not so much opposing, as perhaps two ends of a situational continuum. As a result the same person can exhibit Theory X behavior in one situation, and Theory Y behavior in another. My children provide a perfect example of this continuum. The aim of the RRS is to gently move employees toward the Theory Y end of the continuum.

Reward and recognition is an ongoing process. Evaluation of personnel takes place at appropriate times. The evaluation criteria are posted and known to all employees. An evaluation is made on each criterion. The reason for the evaluation against each criterion is documented (also important for legal and regulatory compliance reasons). The grading of the employee with respect to the evaluation criteria must be objective and fair. Evaluation may be made by several different people and the results for any specific criterion be a weighted sum of all the evaluations. The evaluations for each criterion (if performed by different people) and the normalized results may be plotted as a bar (pareto) chart. Each criterion also has upper and lower limits just like an SPC chart. The upper and lower limits are set so that normal behavior is within the limits. If the RRS is working correctly, most evaluations should fall within the upper and lower limits, i.e., the

process is in control. Any situation in which an employee receives evaluations outside the limits is to be investigated. Exceeding the upper limit may show excellence, falling below the lower limit shows something entirely different. Each is a symptom of a problem that has to be investigated.

The evaluations also have to be checked over time to learn if there is an abnormal pattern. For example there may be a supervisor who never gives a certain employee a good evaluation. The mediocre evaluation may be out of phase with other elements of the evaluation. Today's technology can perform "pattern checking" on evaluations to weed out this situation.

Performance evaluations are discouraged for many reasons including the following:

- **The system is at fault** and people's performance cannot improve within the boundaries of the system. Reference [10]'s "Red Bead Experiment" is often quoted to reinforce this interpretation. However, people are an important part of the system and what they do and how they do it must be measured to be improved. Deming's comments about changing the system have been conveniently forgotten. For example, in the Funnel Experiment [14] the optimal solution was to change the system. The *Excellence paradigm* has changed the system, however, the RRS can still be abused.
- **Half the people will always be performing below average**. This argument has been used as a shield for poor performance. The fallacy in the argument is the definition of average. The systems perspective (environmental model) is to define the average as the average for the industry not the specific organization. Thus, the average may be evaluated for the organizations in the industry, recognizing that half of them will perform below average. The idea is to position the organization as far above the industry average of organizations as possible.

In time, the industry average of organizational effectiveness will tend to move up the continuum toward effectiveness. This effect is seen today in the product dimension. For example, the semiconductor industry has quadrupled the density of random access memory integrated circuits every few years.

SUMMARY

This paper provided a very brief overview of the *Excellence paradigm*, a cost-effective theory of a 21st century Information Age organization.

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