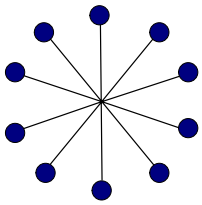
Summary of the Presentation on Holistic Engineering

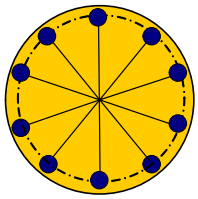
By Alan Kay on the 25th March 2014

Prior to introducing the subject of the presentation, Alan reviewed some of his experiences that related to working in diverse disciplines including mechanical systems, forensic engineering, financial analysis, safety engineering, energy management, environment control and power engineering.

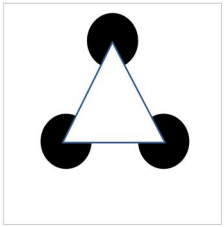


The philosophy of Holism was reviewed encompassing the idea that all the properties of a given system cannot be determined or explained by its component parts alone

Instead the system as a whole determines in an important way how the parts behave.

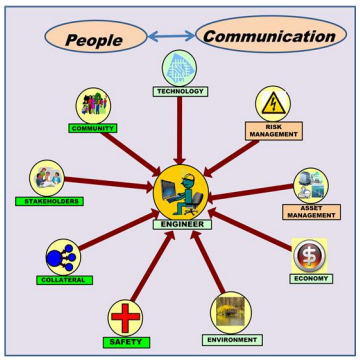


Holism is also supported by the operating principle of Gestalt psychology which maintains that the brain is holistic, parallel and analog with self-organising tendencies

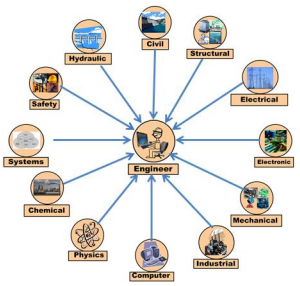


The principle maintains that the human eye sees objects in their entirety before perceiving their individual parts, suggesting the whole is greater than the sum of its parts.

Engineering is defined as the discipline, art, skill and profession of acquiring and applying scientific, mathematical, economic, social, and practical knowledge, in order to design and build structures, machines, devices, systems, materials and processes that safely realize improvements to the lives of people.



The concept of **Holistic Engineering** includes all aspects and all influences that affect the outcome of an engineering process such as technology, risk management, asset management, economy, environment, safety, collateral effects, stake holders, community and above all, the relationships with people. There is no “outside the box”, in effect, there is no box. The Holistic Engineer is capable of dealing with those influences beyond the technology in a pro-active manner.



During the course of their career engineers will be involved with disciplines other than those in which they were trained. The diversification skills necessary to effectively work across disciplines include learning, which involves assuming responsibility, asking questions, seeking answers, analyzing information; judging the necessary depth of understanding in absorbing and assimilating the context, terminology and feel in a manner which will enable a satisfactory working relationship.

Pro-active, hands-on experience with diverse disciplines, such as financial analysis etc., will further enhance diversification skills and empower the engineers' working relationships with practioners and specialists in other fields.

The concept of "Holistic Engineering" was first introduced by Professor Joseph Bordogna in a seminal paper on education in which he posited:…*A new construct for systemic change in baccalaureate engineering education is suggested in terms of a taxonomy of intellectual components connected holistically with a core focus on developing human potential, as opposed to the present system in which students are passed serially through course filters. (Abstract 1995)*

Further research and recommendations by educators and institutes in the US and Canada found that globalisation of the early curriculum of engineering education would develop a new kind of engineer, needed, in this evolving world, who can think broadly across disciplines and consider the human dimensions that are at the heart of every design challenge**.** Rather than watering down engineering education, *the holistic approach empowers engineering programs to become globally competitive, more rigorous, value-added, innovative, and dynamic in their application. It is not the broadening of an engineer's education that disserves the public, but the present educational system that does not train professionals to think holistically about the true impact of their technological and scientific creations in society.*

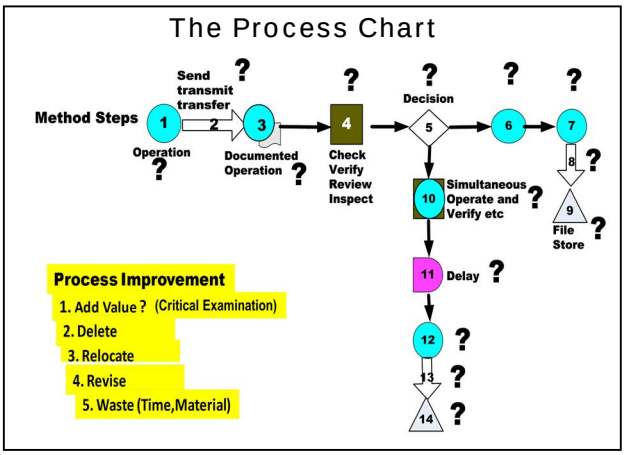
A holistic engineering training *creates the truly 21st century engineering professional who can best meet the complex social, environmental, energy, economic, and technical challenges begging for engineering expertise.*

Developing the holistic engineering approach in the field involves the diversification of hands on experience; rotation through operating departments, where appropriate; providing inter-disciplinary professional career development and encouraging personal responsibility and commitment

A suggested specification for the "Engineer 21" includes; educational achievement based on holistic principles; technological diversity proactive consideration of outside influences; leadership potential; and effective project management capability

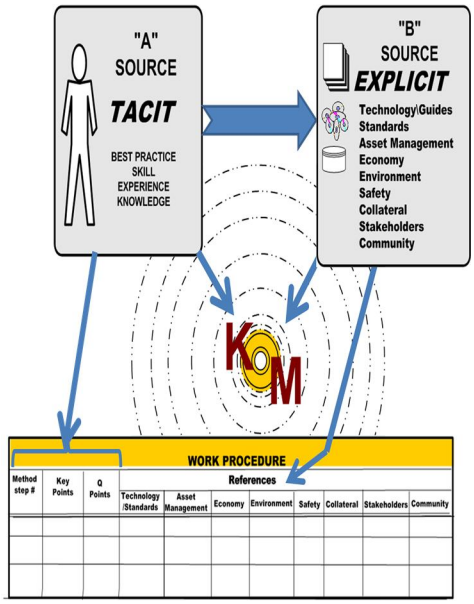
The primary tools for the application of holistic engineering include Process and Knowledge Management. The principle of the concept involves the proactive consideration of outside influences as each step of the process evolves. Currently engineering processes are performed independently from the influences that will affect the outcome.

The holistic approach to process management includes: identification of the enterprise- “the whole”; the identification of the process as an elemental function of the enterprise system; establishing the relationship with other processes; mapping the process method using a Process Chart; the identification of all external influences; the identification of all related knowledge / data; documentation of the process in a “Work Procedure”; and the continuance of process improvement, simplification and innovation.



The chart identifies the process location, its relationship to adjacent processes and maps the method steps. The icon symbols represent the type of action and are based on the international convention. The chart is associated with the Work Procedure but is also used as a basis for process improvement, simplification or innovation using the value added approach, critically examining each step.

Knowledge Management is a conscious strategy of identifying, capturing, organising, storing and delivering needed data and information to the right people at the right time so that they can take action and create value. A management consultant’s report on the operation of an engineering organisation indicated that up to 60% of an engineer’s work time is spent on hunting for information.

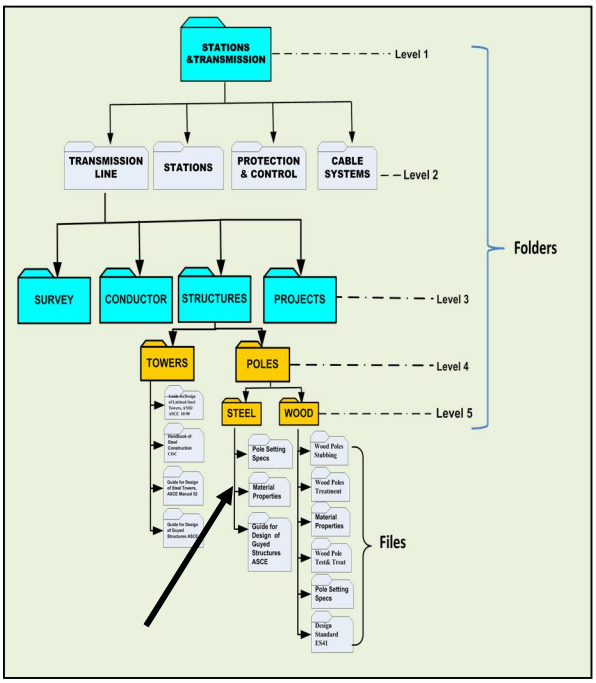


The primary sources of knowledge are Tacit which includes experiential knowledge practice and skill specific to the individual and explicit knowledge which includes all relevant, available information and data relating to technology, methodology codes, standards and all other material beyond the specific technology. Much of the tacit knowledge such as individually developed best practice should be converted into explicit information in order to be shared appropriately.

The work procedure is based on the tacit and explicit information related to each step of the process. The key points will be extracted from the shared tacit knowledge and the explicit

information specific to the method step would be hyperlinked from the information body into the reference section as appropriate.

In any enterprise, information sources would include extractable knowledge from individuals, especially exiting staff; special information and data bases, general information; codes and standards, lessons learned from project issues; and best practices. Where possible all information is fed into the computer.



Effective organisation of information facilitating storage and retrieval will significantly reduce the amount of time spent in hunting for the required material.

The diagram indicates a suggested simple method of storage in the computer avoiding complex IT. The method includes setting up a cascading group of subject based folders in descending levels down to entry of files specific to the lowest level folders.

The diagram shows an application to the Stations and Transmission department of a power utility. In the example a path indicates the retrieval of files pertaining to steel poles.

- **The future holistic engineer will be**; **technologically knowledgeable, competent and diverse; a skilled communicator; cognisant of the environment; committed to sustainability of the assets; sensitive to people and community needs; and self-reliant.**