tribution cable lines, in comparison with single owner/occupier tunnel systems for each cable type.

The functional units for comparison were:

1. 1 x 3m tunnel for 132kV cables (a DNO perspective);
2. 1 x 3m tunnel for 400kV cables (TSO perspective);
3. A combination of the two 3m tunnels;
4. 1 x 4m tunnel for co-location (regulator encouraged position).

It was found that there is a short-term capital investment saving and a long-term whole life cost saving, and significant environmental benefits, from the adoption of a 4m diameter co-located cable tunnel facility rather than the combined 3m diameter cable tunnels costs.

The economic benefit of the 4m co-location cable tunnel in regard to total Type I to III costs, covering all direct, indirect and contingent liability costs, is equivalent to a saving of between 26% and 36% over the combined 3m tunnel modal cost. When the intangible internal and external Type IV and V costs are also accounted for, the overall economic benefit of the 4m co-location cable tunnel spans a saving of 11% to 27% with respect to the combined 3m tunnel modal cost.

However, the level of additional co-location risk must however be carefully considered, particularly in regard to cable circuit operational factors such as thermal management, cable current ratings and also the possibility of cable joint failures and tunnel fires.

Conclusion

The new methodology for whole life costing and risk assessment of assets provides a powerful and insightful integration of assessments associated with economic and environmental risks. It is a very useful an assessment of the risk of technology selection, operation and management, overall policy and health and safety issues [5].

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Mechatronic device objectives

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1 INTRODUCTION TO MECHATRONICS.

Mechatronic is a term coined by the Japanese to describe the integration of mechanical and electronic engineering. More specifically, it refers to a multidisciplinary approach to product and manufacturing system design [1]. It represents the next generation machines, robots and smart mechanisms for carrying out work in a variety of environments predominantly factory automation, office automation and home automation as shown in figure 1.1(a) [3].

As a discipline, mechatronic encompasses electronics enhancing mechanics (to provide high levels of precision and reliability) and electronics replacing mechanics (to provide new functions and capabilities). Some examples where mechanics has been enhanced by electronics are numerically controlled machines tools which cut metal automatically, industrial robots and automatic bank tellers.

The products where electronics replaces mechanics include digital watches, calculator or others. However, the products that really blur the distinction between electronics and mechanics are machines and robots driven by numerical control [2].

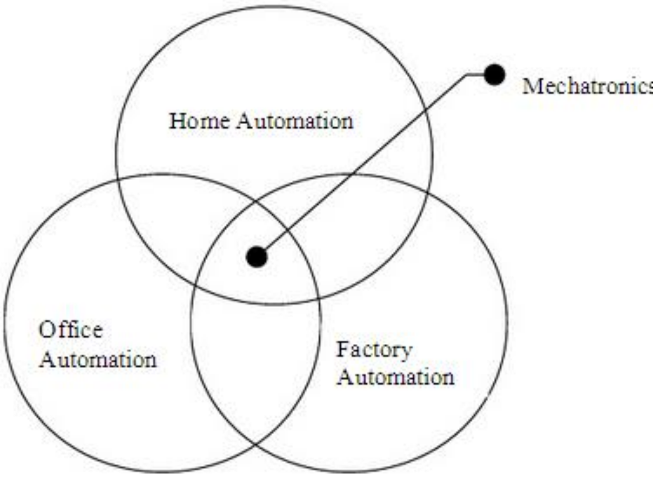

Figure 1.1 (a): Domains of mechatronics.

Japan is the first country in the world to have mastered the NC machines technology and as a result the Japanese machine tool industry has flourished. This is because the Japanese have mastered mechatronics, the fusion of precision mechanics and electronics in design, engineering and manufacturing, which are popularly depicted by the Japanese as shown in figure 1.1(b) [3].

2 SCOPE OF MECHATRONICS.

Since the 1970s, there has been a dramatic change in the technology of these products, mainly an increasing content of electric and electronic systems integrated with the mechanical parts of the products, mechatronic. Example of products which have already moved to mechatronic technology from simple mechanical products are [4]:

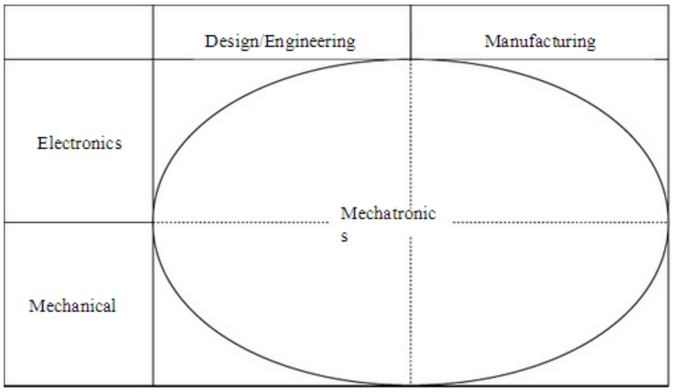

Figure 1.1(b): Concept of mechatronics.

a. Machine tools incorporating computer numerical control (CNC), electric servo drives, electronic measuring systems, precision mechanical parts, such as ball screws, antifriction guide ways and each other's.
b. Electronic watches incorporating fine mechanical parts and complex electronic circuits.
c. Electronic consumer products – washing machines, electronic cooking appliances, fax, plain paper copiers and others.

In the last twenty years, the production technology has seen the introduction of high precision measuring instruments such as electronic gauges and measuring instruments, in process gauge and quality control instruments, laser measuring systems and others to ensure high dimensional accuracies, as well as increased productivity on the shop floor.

In the domain of factory automation, mechatronics has had far-reaching effects in manufacturing and will gain even importance in future. Major constituents of factory automation include NC machines, robots, automation systems and computer integration of all functions of manufacturing. Proper application, utilization and maintenance of these high technology products and systems is an important aspect that enhances the productivity and quality of products manufactured by the customers. To ensure correct selection of equipment, an accurate estimation of the techno-economics of various manufacturing systems, developments in the high technology machines and equipment are studied in detail. Also, proper maintenance of various mechatronic elements, diagnostics can increase the life of the various mechatronic elements, which in turn will enhance the life of the product or system. Such inputs in mechatronics can be best given by the manufacturers of hi-tech machines and manufacturing systems. In fact, the machine tool manufacturers are now being called upon to offer a total manufacturing for solution in production, by the customers, rather than supply of just the stand-alone machines. This trend is already evident in many of the advanced countries. Evidently, the design and manufacturing of future products will involve a combination of precision mechanical and electronic systems and mechatronics will form the core of all activities in products and production technology.

3 TYPES OF MECHATRONIC DEVICES.

The types of mechatronic devices is used such as switches, relay, solenoid, power diode, power transistor, thyristor, gate controller switch, rectifier, chopper, transducer and others [5].

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Nanotechnologies in the Electrical Energy Sector

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Nanotechnology is an interdisciplinary field of basic and applied science and technology, which deals with the accumulation of theoretical basis and practical methods of investigation, analysis and synthesis, as well as methods of manufacture and use of products with a given atomic structure by controlled manipulation of individual atoms and molecules.

Nanotechnologies are worldwide regarded as key technologies for innovations and technological progress in almost all branches of economy. Nanotechnologies refer to the target-oriented technical utilization of objects and structures in a size in the range of 1 and 100 nm. They are less seen as basic technologies in the classical sense with a clear and distinct definition, since they describe interdisciplinary and cross-sector research approaches, for example in electronics, optics, biotechnology or new materials, using effects and phenomena which are only found in the nano-cosmos.

Nanotechnologies provide the potential to enhance energy efficiency across all branches of industry and to economically leverage renewable energy production through new technological solutions and optimized production technologies. In the long run, essential contributions to sustainable energy supply and the global climate protection policy will be achieved. Here, nanotechnological innovations are brought to bear on each part of the value-added chain in the energy sector.

Low-Loss Power Supply through Nanomaterials.

Considerable progress was made in the development of high-temperature superconductors in the last years through the production of yttrium-barium copper oxide (YBCO) on me-