Professional Ethics in Engineering

Background   (5 hours)

1.0	**Background**
1.1	History of Engineering practice
1.2	Cultural, Political, Societal motivations and limitations
1.3	Impacts and consequences of technology on society
1.4	Education and training of technologists, scientists and engineers

Prof. Dr. Hari Krishna Shrestha

Nepal Engineering College

Changunarayan, Bhaktapur

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1.1 History of Engineering Practice

- Engineering: Application of data, information, knowledge and technique for practical beneficial use.

- "Beneficial for whom?" and "Are the benefits sustainable?" are relatively modern issues in Professional Engineering Practices.

  - If a particular engineering project benefits only a few persons in a society, is it justifiable? If an engineering project's benefit is unsustainable, should the society promote it?

1.1 History of Engineering Practice

Short History of Engineering Practice

- Concrete is used for arched bridges, roads and aqueducts in Rome (1200 BC-1 AD)

- Gunpowder use improved (1-1000 AD)

- Manufacturing and use of silk and glass (1000-1400 AD)

- Toilet, telescope, vacuum, and Gas Law (1400 – 1700 AD)

- Industrial revolution, steam engine, Society of Engineers (UK), cast iron building (1700-1800 AD)

- Mechanical automation, railroad, telegraph (1800-1825 AD)

- Reinforced concrete, synthetic plastic material, Oil well, mass production of steel, typewriter (1825-1875 AD)

- Telephone, light bulb, gasoline engine, automobile (1875-1900 AD)

1.1 History of Engineering Practice

Short History of Engineering Practice (continued...)

- Aeroplane, diesel engine, commercial flight, mass production of automobile (1900 – 1925 AD)

- TV, atom bomb, transistor (1925-1950)

- Computer, artificial satellite, moon landing, electronic hand held calculator (1950-1975)

- Supersonic plane, reusable rocket, artificial heart (1975-1990)

- Robot, under-sea train, internet, email, GPS (1990-2000)

- 2000 onwards: Exponential expansion in application of engineering affecting daily life: Continuous connection anytime, anywhere, mobile phone, electronic surveillance of equipment and people, automation of virtually everything, instant access to data and information, service industry dominating manufacturing.

1.2   Cultural, Political, Societal motivations & limitations

- Cultural practices, customs, rituals, and belief systems can motivate or demotivate development and adoption of science and technology.
    - low value of time and punctuality, low value of work, intellectual property right and copy right, research
    - more value to ritual, predestination, formality, religion, tradition, caste
- Political systems can create conducive environment or hurdles in development and use of science and technology.
    - Authoritarian, despotic, repressive, lack of rule of law, impunity, irregular and selective application of law, lack of freedom of expression and choice frequently changing policies and rules, vague regulations
- Social norms and values can encourage or discourage (assign arbitrary limits) people to be professional engineers.
    - Gender-class-caste roles, defective social norms and values, gap between rich and poor, access to health and education, social security, conflict, rent seeking culture, suspicion of new ideas and technologies

1.3 Impacts and consequences of technology on society

- The impacts and consequences of technology on society are multifaceted (consequences are positive or negative, depending on use or abuse, or ability to prevent abuse)
- Impact on social values and family structure
- Impact on cultural norms
- Impact on transportation of goods and services
- Impact on communication and information generation
- Impact on production means and price of goods

1.3   Impacts and Consequences of Technology on Socio-economic parameters (positive): a) Agriculture

Impact on	Impact
Food Production	Mechanized, increasing, Green Revolution, GMF, vertical hydroponic
Food Processing	Food processing getting complex, requiring industrial management
Food Preservation	Food security increasing, for most, better food preservation
Commercialization	From subsistence to cash crop, patented seeds and food processing techniques
Food Variety	Increasing, year round availability, no more seasonal
Fertilizer/Pesticide	From organic to chemical, pesticide use increasing
Water use	Increasing due to cash crops & agricultural intensification; reduced by micro-irrigation
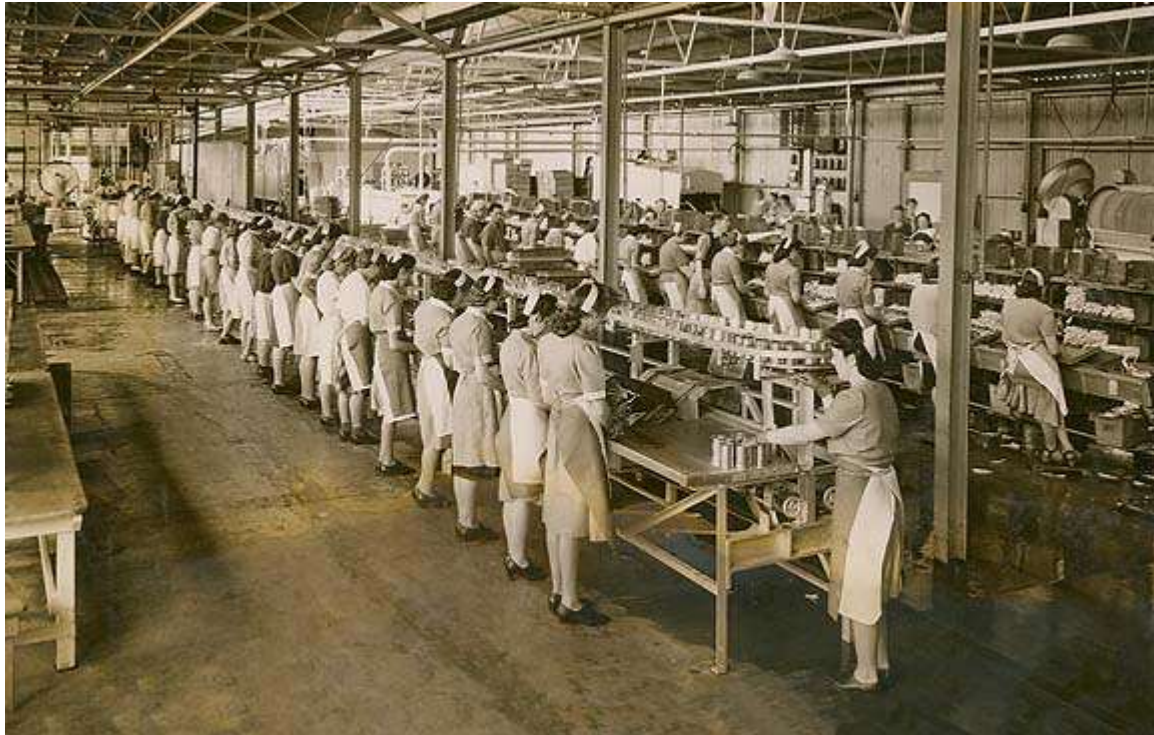
From traditional to modern food processing

1.3 b   Impact on Communication

Impact on	Impact
Information generation and dissemination	Increasing access to information
Mass communication: Newspaper, Magazines, FM Radio, HAM radio, TV, instant/breaking news	Enhanced public awareness, timely information to people
Internet and Social Media	Increased access to information, social media influencing design of communication techniques
Telephone, mobile phone	Increased and easier access to telephone
Virtual Meeting, virtual reality, tele-medicine	Less need of physical presence in meeting, distance medicine services and remote controlled operation possible

1.3 d   Impact on Information Generation, Storage and Dissemination

Impact on	Impact
Information access	Increasing access to information through multiple mediums
Storage, virtual storage	Tape, Floppy disk, CD, DVD, External hard disk, Dropbox, Cloud storage, mailbox
Generation	Information generation growing exponentially, automatic data logging, GIS, GPS, Satellite Images, Remote sensing
Dissemination	e-paper, interactive TV, internet, social media

1.3 e   Impact on Dispute/Conflict Resolution

Impact on	Impact
Warfare	Increased use of gun power, rockets, missiles, drones, improvised explosive devices, chemical-biological
WMD	A-bomb, H-bomb, nuclear bomb made but not yet used (except two in WW II), Star War, MAD policy
Evidence	Evidence recorded in electronic media

1.3 f   Impacts on Family Structure, Culture and Livelihood

Impact on	Impact
Family	Family relation more complex, IV-fertilization, test-tube baby, cloning, surrogacy, same sex marriage, family size reducing, micro-family getting possible, life span increasing, change in status of female and disabled
Tradition/ Culture	Traditions-values challenged and altered or replaced, heritage preservation better
Recreation	Traditional dances/music/drama/games giving ways to movies, video games, theme parks, pay per view
Social Norms and Values	Social norms and values increasingly challenged and altered or replaced, social class structure disintegrating, new economic class emerging
Language	International language use increasing, language getting standardized, brail script & sign language use increasing
Livelihood and living standard	Livelihood diversification & specialization increasing, Living standard & HDI increasing, poverty decreasing, employment opportunity increasing, price decreasing

World solar power capacity increased **35%** last year

Global Cumulative Installed Solar Capacity 2000 -2013 (MW)

The Digital Disruption Has Already Happened

- World's largest taxi company owns no taxis (Uber)
- Largest accommodation provider owns no real estate (Airbnb)
- Largest phone companies own no telco infra (Skype, WeChat)
- World's most valuable retailer has no inventory (Alibaba)
- Most popular media owner creates no content (Facebook)
- Fastest growing banks have no actual money (SocietyOne)
- World's largest movie house owns no cinemas (Netflix)
- Largest software vendors don't write the apps (Apple & Google)

Electrical Vehicle

- First electrical vehicle: 1937 Robert Davidson
- In 1912: 38% of vehicles in US were electrical
- Volvo: No gasoline based vehicle (GBV) production from 2019 (only two years from now)
- France: Ban on use of GBV from 2040
- Germany: Ban on trade of GBV 2030
- Netherlands, Norway: Ban on trade of GBV from 2025
- India expected to follow suit.

Computer and Computer Crimes

Computer:
* Modeling, simulation (visualization of potential impacts and solution before the event occurs and solutions implemented), design, solution techniques (FDM, FEM), Management Information System, Spatial planning using GIS, computer crimes, intrusion on personal privacy, data mining, data theft,

Effects: information generating, storing and dissemination
* Design of materials using simulation
* Electronic equipment

Electronic Transaction Act 2063 (2006) has listed the following acts under the Computer Crime
* Theft, damage or alteration of computer source code
* Unauthorized access to materials on computer
* Destruction and computer and information system
* Publication of illegal materials on electronic form
* Violation of confidentiality
* Posting of false information
* Submitting or showing forged license or certificate
* Non-submission of the document or other materials
* Computer fraud

1.4 Education and training of technologists, scientists and engineers

- Continuous education and training (E&T) is a regular process for the technologists, scientists and engineers (TSE)
- New concept, knowledge, technology, hardware and software, materials, equipment, tools, gadgets, keep coming in the market. New policies, acts/laws, rules and standards are periodically adopted. The TSE need to keep up with the latest developments to prevent themselves from being out of date.
  - Information & Technology Policy 2000; Science & Technology Policy, 2005
  - The Electronic Transactions Act 2006
  - Electronic Transactions Rule 2007
  - Nepal Electronic Cheque Clearing Rule Book, 2011 (ECC Rule)
  - e-governance, e-bidding, e-procurement, e-banking, e-sewa,
  - High Level Commission for Information Technology
- Nepal Administrative Staff College caters to the continuous E&T needs of administrative staff; no similar institute for TSEs in Nepal.
- Continuing Education Division/IoE partially caters to the needs of TSEs
- Currently a myriad of different organizations are filling the gap of lack of formal system of E&T for TSEs in Nepal.

Nepal is a poor, underdeveloped nation, but has enacted a good E-commerce law—the Electronic Transactions Ordinance.[181] The following provisions are especially noteworthy: the Information Technology Tribunal and Appellate Tribunal, possibly the best system of specialized computer dispute resolution in the world; the explicit claim of "long arm" jurisdiction over foreign parties involved in E-commerce disputes with citizens of Nepal; the comprehensive list of computer crimes; compulsory licensing of CA's; the Controller's mandatory annual audit of CA's; and the Controller's right to demand a subscriber to turn over his private key in specified situations.

Potential Questions

- List the type of cultural, political and societal practices which motivate development of science and technology in a society.
- List the type of cultural, political and societal practices which limit development of science and technology in a society.
- What is the impact of development of ICT in social values?
- What is the impact of computers in mechanized production, and how has it impacted society?
- What are the different forms of computer crimes, and how has computer crime impacted society?
- What should be the modality of the education and training of the technologists, scientists and engineers?
- What specific type of training should the electronics engineers and/or electrical engineers be provided?