Impact Of Engineering Solutions on Society

Retrospect, Reflections & Lessons

By

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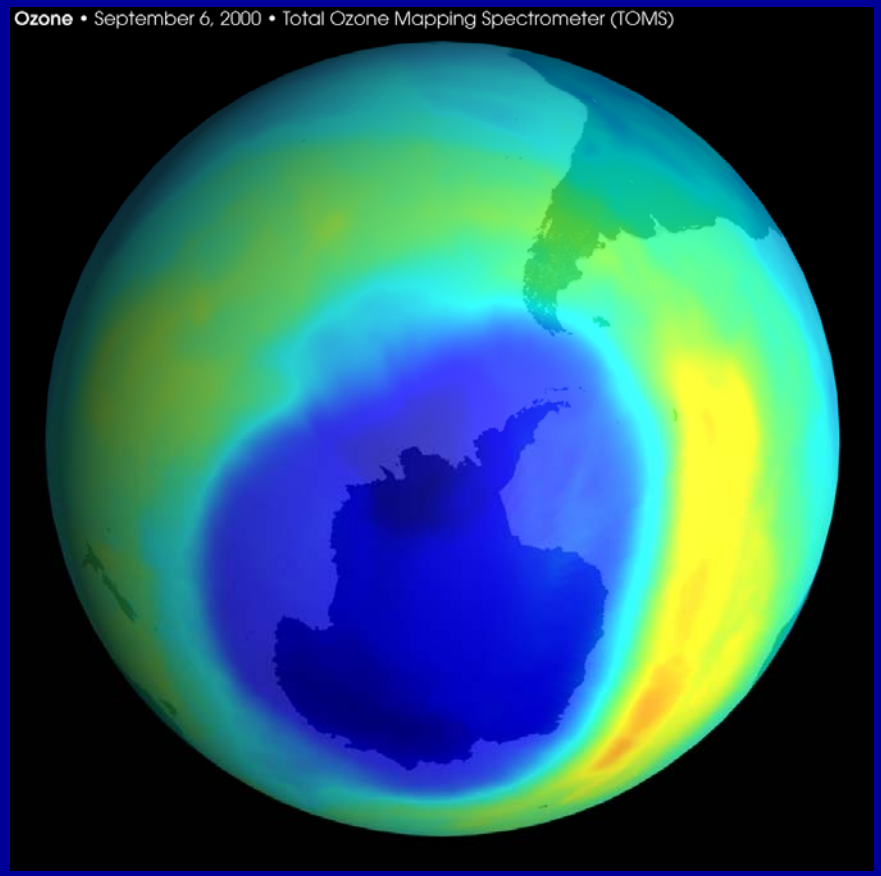
Why is it important to think about impact of engineering solutions on society?

- In the era of market and work-force globalization engineers need a solid understanding of the impact their products have locally as well as globally → This represents possible
  - Opportunities,
  - Liability Need to “think globally act locally”
- In recent surveys, engineering employers placed “capacity for independent and critical thinking” ahead of logical and orderly thinking and academic learning, while at the same time rating recent graduates as poor in problem solving, business communications, and “particularly poor at critical and independent thinking”
- There have been many cases where the engineers involved in the creation of a particular solution, constrained with a limited view of the situation they were trying to address, were not aware or could not possibly imagine the impact their product would later have on the society as a whole

Examples of negative impact of engineering solutions (other than IT)

I. General Examples:

- **CFC's as coolants: Chosen for their excellent heat capacity → but caused destruction of the ozone layer**



More General Examples

- **Indoor water circulation and public sewage systems: Solved a huge problem, improved sanitary conditions immensely, elevated people's standard of living significantly → But caused extensive pollution of water resources (underground water, lakes, rivers even tab water)**

- **Automobiles: Solved the transportation problem, allowed faster movement of people and goods → High fatalities from accidents, pollution, green house effect (Global warming)**

Specific examples

- **High dam, in Aswan, Egypt: Eliminated flooding of villages, ensured a reliable water supply, provided a source of clean energy → Adversely affected farm lands by depriving it from nutrients carried by flood water, affected fish population, caused the displacement of a large population which virtually eliminated one of the oldest cultures/communities in the region**

Specific examples

- **Large wind farms in northern Europe (electrical generators that harness the wind power using giant turbines): Provided a source of clean energy → Caused a noticeable increase in temperature in Europe due to interference with natural heat transfer by wind**

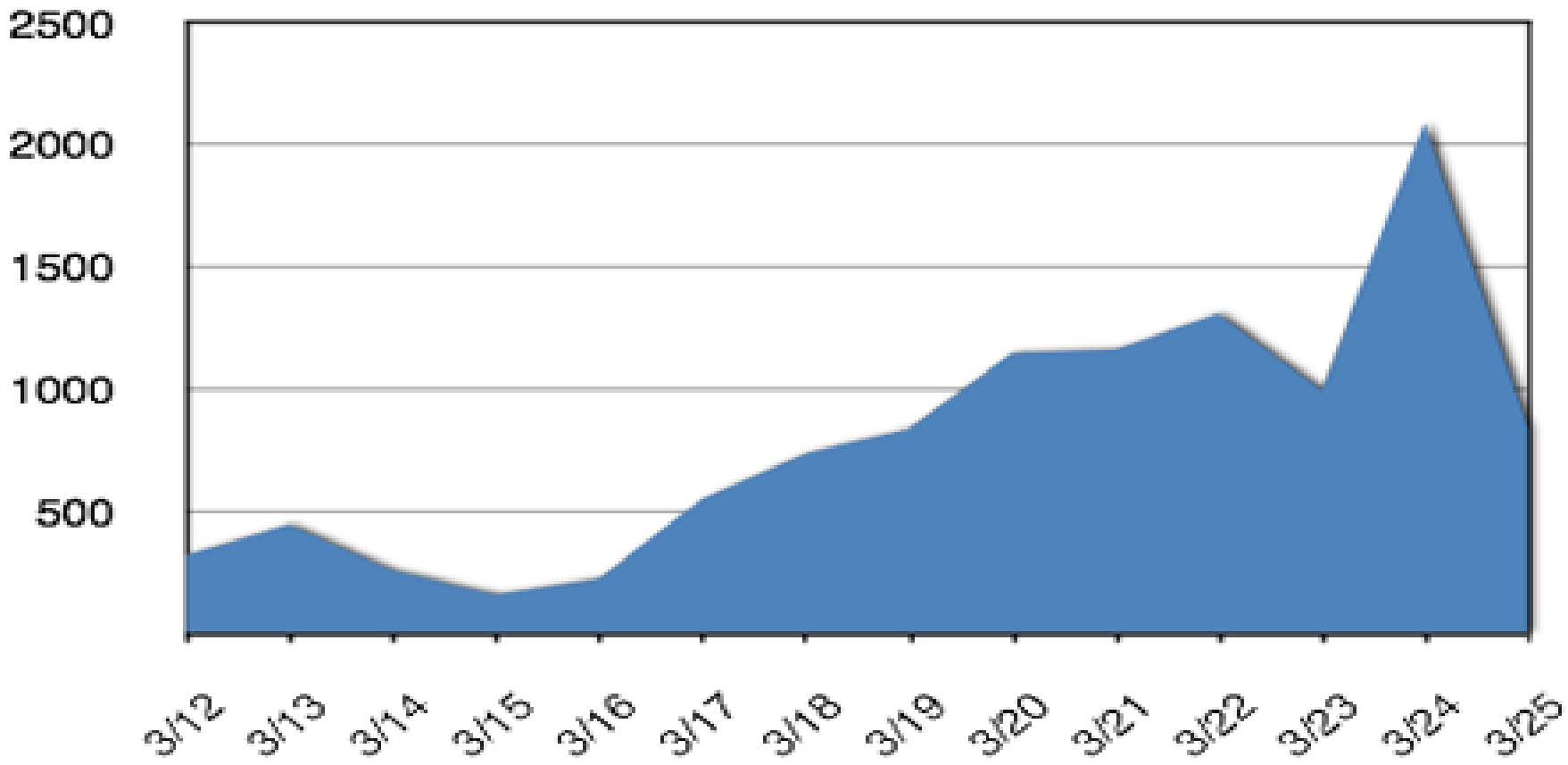
Examples of negative impact of IT solutions

- Computer Communication Networks (including the Internet and the World Wide Web): Some of the advantages
  - Extremely cheap communication medium,
  - Resource sharing,
  - Enabling of collaborative work,
  - Knowledge sharing on an unprecedented scale,
  - Ominous availability of information,
  - Huge opportunities,
  - Low overhead business solutions,
  - e-government, …etc.

Negative impact of Computer Networks, *Contd*.

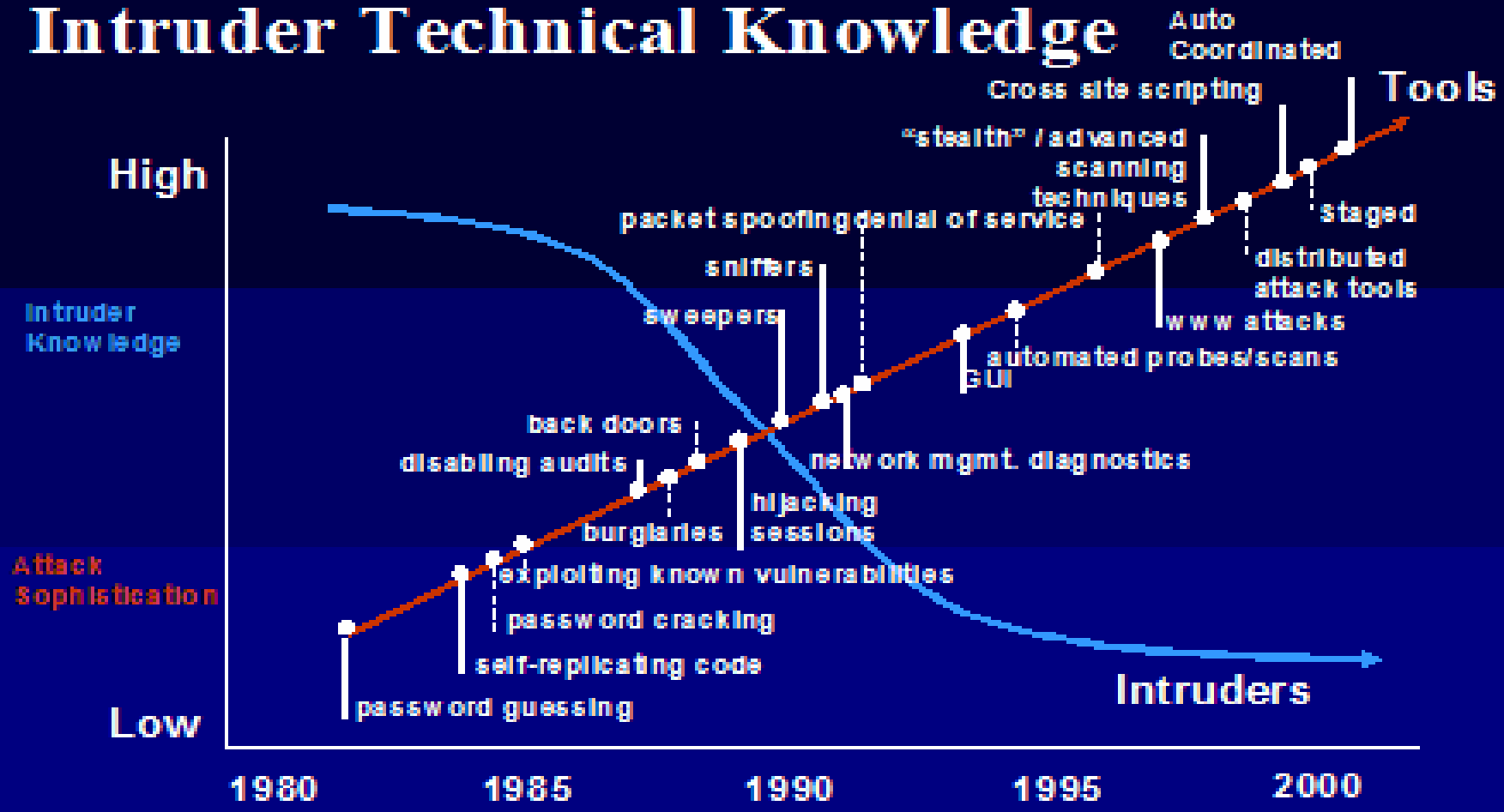
- However …
  - When these solutions were created malicious use (or misuse) was not thoroughly evaluated … vulnerabilities (at all levels) have been and are been continuously discovered and exploited to launch security attacks
  - No inherent measures for protecting privacy … misuse of personal information and identity theft became very prevalent

→ loss of productivity, increased cost, hurt technology image and made people less receptive of new IT solutions → delaying or even reversing progress!



Number of severe security events per honeypot detected in a 24 hour window each day

Attack Sophistication vs. Intruder Technical Knowledge



Severer attacks are on the rise, requiring less knowledge to launch them!
A recipe for disaster

Negative impact of Computer Networks, *Contd*.

- More …
  - Also, no inherent measures/techniques to allow communities to guard against what they perceive as cultural invasion or assault on their social values and ideals → delayed their acceptance of the internet (and all its benefits) till acceptable censorship solutions were developed

  → Lessons: Products/solutions have to be made acceptable to all societies they are meant for. Engineers can not (and are not meant to) impose their value systems on others! If they try to do that (intentionally or unintentionally) their products will fail miserably!

Examples (from our own backyard!) of negative impact of IT solutions

- On-line registration at KFUPM:
  - Fast and efficient procedure
  - All choices are readily available to students,
  - Students can register on their own convenience without the need to miss classes,

  → But the specific implementation lead to:

  → No student interaction with academic advisors → more wrong decisions by students with sometimes catastrophic results

  → Grouping the students based on class level meant students will be accessing the same records simultaneously → Huge bottlenecks and some time unfair access to courses → counterproductive to the original goal on-line registration was suppose to achieve!

More Examples (from our own backyard!)

- The Electronic Resource Planning (ERP) System at KFUPM: Was meant to …
  - Automate all business processes at KFUPM,
  - Save time and efforts of all involved (Faculty, staff, and administration),
  - Save resources (e.g. paper) and increase efficiency while providing complete transparency

→But the specific implementation lead to:

→Huge increase of complexity of majority of business processes → Requiring more time and effort → Less efficiency → counterproductive

Potential Impact of Computer Engineering

- Computer Engineers can impact Saudi society in two major ways:

1. **Provide communication/networking solutions for businesses and government agencies →**

   Potential Benefits: Faster and cheaper movement of goods and services, more opportunities, farther reach, added value, resource sharing, faster ROI, significant contribution to the overall economical growth of the Kingdom

   Potential Pitfalls: Security and privacy issues, over-design, single point of failure, congestion, bottlenecks, compatibility with existing components, maintenance, low amortization (limited re-use potential) … → can cause frustration and reduced deployment (hurtful to the whole profession)

Potential Impact of Computer Engineering

2. Provide automation solutions for businesses and government agencies (office/business/factory automation)

   Potential Benefits: Increased efficiency, speed, reliability, quality and reduced cost

   Potential Pitfalls: Lack of compliance with standards, poor architectures (congestion, bottlenecks, catastrophic failures), half-automation (worse than manual processes), increased complexity, over-automation, … → Again a big turn-off

Lesson: When devising a solution or a product, social interaction, cultural bias, customer sophistication, technological trends (forecast) and contemporary issues must be all taken into account … Learn from history Do not repeat it!