Who is Michael Polanyi?

- 11.3.1891 (Budapest) – 22.2.1976 (Northampton, UK)
- polymath
  - medicine
  - physical chemistry
  - economics
  - social sciences
  - philosophy

Figure 1: Michael Polanyi

Pearl of Computation?

- Was friends with Alan Turing
- His work influenced Hubert Dreyfus’ critique of AI
- Founded Society for Freedom in Science with John Baker in 1940
- Contributed to the analysis of monetary systems (1945)
- Contributed to the philosophy of science
- Influenced knowledge management

Figure 2: The ‘Money Circle’

Why Michael Polanyi?

- As a first year student, we had to prove convergence of infinite series
- Students asked the teacher:
  - How did you get the limit?
  - How did you choose \( n_0 \)?
  - How did you know which test to use?
- The teacher answered:
  - It just came to me
  - I tried
  - I was lucky
- I taught concurrent programming
- Students had huge issues with programming assignments
  - It did work!
  - I see this error, but it goes away!
  - Sometimes it just stops!
  - Why does my machine crash?
- I could identify the issue within minutes
- To students, this was like magic
  - How did you do this?
Freedom in Science

[Scientists, freely making their own choice of problems and pursuing them in the light of their own personal judgment, are in fact co-operating as members of a closely knit organization.

Such self-co-ordination of independent initiatives leads to a joint result which is unpremeditated by any of those who bring it about.

Any attempt to organize the group ... under a single authority would eliminate their independent initiatives, and thus reduce their joint effectiveness to that of the single person directing them from the centre. It would, in effect, paralyse their co-operation.

All knowledge is personal

- All knowledge claims rely on personal judgements
- All knowing, no matter how formalised, relies upon commitments that motivate discovery and validation
- Scientific methods do not mechanically yield truths
- Scientists chose significant questions likely to lead to successful resolution
- We believe more than we can prove, and know more than

Positivism dispute

- Logical positivism: When is a philosophical method valid?
  - must be communicated in language
  - must be observable/empirical or deduced from observables
  - Observables are inter-subject conventions
- Are economics and social science actually sciences?
- Is social science a normative obligatory statement in politics?

- 1935: Karl Popper “Logik der Forschung”
- 1937: Max Horkheimer “Der neueste Angriff auf die Metaphysik”
- 1958: Michael Polanyi: “Personal Knowledge”
- 1966: Michael Polanyi: “The Tacit Dimension”
- 1969: “Der Positivismusstreit in der deutschen Soziologie” marks the end of the dispute

Example from computing

- 1900: David Hilbert 2nd problem: “Prove that the axioms of arithmetic are consistent.”
- 1928: Hilbert recasts the problem: Is mathematics consistent, complete, decidable?
- 1930: Gödel announces proofs of undecidability
- 1936: Church “An Unsolvable Problem of Elementary Number Theory” characterizes effectively calculable
Example from computing

- 1931: Gödel “On Formally Undecidable Propositions of Principia Mathematica and Related Systems I”
- 1936: Church “A Note on the Entscheidungsproblem”
- 1937: Turing “On Computable Numbers With an Application to the Entscheidungsproblem”
- 1939: Rosser notes the equivalence of effective method proposed by Gödel, Church, and Turing.

Gödel, Church, and Turing defined their personal notion of computation:
- Recursive functions
- $\lambda$-calculus
- Turing Machine

Same result in different formalisms
- Rosser notes the equivalence, allowing objective formulation

Personal Knowledge (cont.)

- Experience is not “sense data”
- Interpretive frameworks don’t trap us in experience
- Tacit awareness connects us with reality
- Tacit awareness supplies context within which articulations have meaning
- Minds cannot be reduced to collections of rules

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Tacit knowing

- Polanyi’s most important discovery
- “We can know more than we can tell”
  - Skills, ideas, and experiences
difficult to access because not codified
often cannot be codified
- Tacit knowledge is “know-how” – not “know-that”, “know-why”, or “know-who” (explicit knowledge)
- Bessemer steel process
- First inexpensive industrial process for mass-production of steel from molten pig iron
- Removes impurities by blowing air into molten pig iron
- Buyers of the patent could not get it to work from the verbal description
- Bessemer set up his own company
  - He could use the method
  - He could now convey it to the users

Process of
- creating knowledge
- sharing knowledge
- using knowledge
- managing knowledge

Long history
- Master-apprentice relation
- on-the-job discussion
- discussion forums
- libraries
- training
- mentoring
- corporate culture

Tools
- collaborative software (wikis, blogs, social software)
- expert systems
- expert directories (stack overflow)

Technologies
- groupware
- content management
- eLearning
- version control

Knowledge management

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The first Bread Maker

- Tacit to tacit:
  - Learn bread making with master
  - Doesn't create systematic insight
- Explicit to explicit:
  - combining information
  - no knowledge creation
- Tacit to explicit:
  - formalizing and coding bread making
  - mechanism and algorithm for the bread maker
- Explicit to tacit:
  - transformation steps create knowledge

Figure 5: Raku Raku Pan Da

Model of knowledge transfer

- Nonaka and Takeuchi (1995) were influenced by Polanyi:
  - Explicit knowledge is obtained through learning
  - Tacit knowledge is obtained through experience
- The distinction of explicit and tacit introduces:
  - Externalization: formalising tacit knowledge
  - Internalization: obtaining tacit knowledge from formalisations

Conclusion

- Chemistry (skipped)
- Freedom in Science
  - scientists are naturally cooperating
  - more effective when unorganised
- Personal knowledge
  - personal judgement
  - scientists motivation
  - no mechanical method
  - tacit awareness
  - mind not collection of rules
- Tacit knowing
  - explicit vs tacit knowing
  - tacit knowing
    - cannot be formalized
    - obtained through experience
- knowledge transfer (SECI)
  - transfer through socialisation codification
  - internalisation
- My answer: tacit knowing in computing obtained through repeated application in applying formal knowledge

Bibliography


Bibliography (cont.)


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