perspectives in OR

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- OR tookoff in 1930's in the UK with the aim of winning the war against Nazi Germany
- navy officer and physicist Blackett was asked to form a team from all areas of academia
- to deal with problems such as where to deploy radar stations, how best to protect convoys of ships, what depth to explode charges in the ocean etc..
- which were all well defined, single purpose, straightforward problems
- there was no need for philosophical reflection
- and OR proved to be famously successful

- the war ended, OR had now in its sights almost anything to do with human affairs in general
- most early left wing socialist practitioners of OR belived OR was for the betterment of the society rather than commercial organisations
- but commercial interests won the day and even Blackett, a socialist and Nobel prize winner was no more consulted despite his enormous prestige and returned to the university
- however, the problems of industry were not always single purpose, and in many cases, optimisation based OR failed to work as expected

- so now OR had to think and find some philosophical grounding if possible, to make quantitative analysis meaningful and more productive
- the rise of empirical sciences in the 17th century Enlightenment had established the supremacy of reason opening in the age of modernity
- OR's problem was the same as that of modernity; both had regarded the rationalisation of economic activity as unquestionable, which tends to overpower all other areas of human action that makes our lives meaningful
- in this talk we shall summarise some insights OR has so far acquired that are rooted in philosophical perspectives

ancient Greece and later

- Aristoteles was perhaps the first thinker who proposed a systematic classification of the types of knowledge that still holds today
- *theoria*, ie. scientific knowledge; *poiesis*, knowledge for production or technology; *praxis*, knowledge of the interactions of individuals with other individuals and with society
- *theoria and poiesis* can be possible with rational thought, the idea that gave rise to the emergence of science
- *praxis* is associated with ethics, morality, justice and politics; ie. with normative choices that cannot be subjected to rationalisation

- theoretical inquiry proceeds with analysis whereas practical inquiry must proceed with dialectics
- this does not mean that theory and practice can be separated, but that they are separated only in their methods of inquiry
- hence knowledge is indivisible and is associated with the whole system
- later Hegel would put it as follows: ‘‘ *the true is the whole, but the whole is only the essence perfecting itself through its development*’’
- this relates directly to OR, as Churchman puts it: ‘‘*the joy of OR is that it is in the center of the deepest mysteries of the human race, because, academically speaking, it has taken on the whole system*’’

- the classification of knowledge into the theoretical and the practical survived for 2000 years
- during this time the path to scientific knowledge was supposed to follow either of two traditions: rationalism or empiricism; the first associated with Plato, and the second with his pupil Aristoteles
- rationalism says that all knowledge is acquired using deductive inference, or logic ; this type of knowledge is a priori; experience can only awaken dormant knowledge
- empiricism on the other hand says all knowledge is based on experience and is the product of inductive inference

- according to rationalism cognitive propositions (ie. propositions to do with thought and inference) must be analytic; according to empiricism they all must be empirical
- analytic statements are of the form: “A is B” where A belongs to B; eg. ‘’*all fathers are male*’’ and hence they are a priori tautologies
- empirical propositions however, in which A does not necessarily belong to B, are said to have empirical content; eg. ‘’*all fathers are liars*’’
- the difficulty with empirical propositions is that induction cannot lead to a generalisation since contrary evidence cannot be ruled out
- Hume defined this as the problem of induction which discards for good, the possibility of proof in science

Kant's synthesis

- both rationalism and empiricism are important but both run into difficulties
- it was Kant who resolved the conflict by reclassifying cognitive propositions as either analytic or synthetic, and at the same time as either a priori or a posteriori
- analytic propositions are necessarily a priori, that is they are all analytic a priori; and therefore analytic a posteriori propositions are impossible
- also clearly, most synthetic propositions must be synthetic a posteriori, meaning that they cannot be validated a priori to experience
- hence these two classes of propositions were not interesting

- instead he proposed
  - that synthetic a priori propositions were essential for knowledge, involving categories with which to organise thought, such as unity, plurality, existence, necessity, causation etc.
  - that reality appears to us through these a priori categories with which we are born and without which we cannot make sense of our experiences
- propositions such as "every effect has a cause" or "*1+1=2*" for example, are synthetic apriori and their validation using either deduction or induction is not possible; but we have to live with them since otherwise, cognition and knowledge will not be possible

- in this way Kant has reconciled rationalism and empiricism and has shown us how to live with the problem of induction
- he wrote three books; Critique of Pure Reason, Critique of Practical Reason and Critique of Judgement respectively (i) on science, (ii) on practice and (iii) on aesthetics; explaining how human reason can deal with these issues that collectively cover all human practice
- reason would prevail and,
  - will ensure an ethical life;
  - will also ensure the liberation of the individual from domination

- to put weight to his arguments he formulated categorical imperatives arguing that the rightness, or the morality of conduct can be determined a priorily, using pure practical reason
- one version of his imperative reads: ‘‘*act in such a way that you treat humanity, whether in your own person or in the person of any other, never merely as a means to an end, but always at the same time as an end*’’
- failure to follow the imperative would be self-defeating and thus contrary to reason

- criticism of Kant

- Kant's universal conception of ethics came under criticism by Hegel, by Marx and others
- for Hegel, moral instructions such as Kant's categorical imperative, could not apply to a society; they were too abstract anad vague
- more importantly, Hegel's dialectic denied unchanging principles upon which any system could be founded, since ideas themselves were in a continual state of change, as we pointed out earlier
- he wrote of a dialectical historical process and a dynamic ethic upon which the judgements of history rested

- similarlay Marx argued that what is good or bad were determined by the economic structure; that the ethics of any community depended on the infrastructure of production and reflected the interest of the dominant class
- he was quite realistic about this and dismissed altogether the idea of a universal ethic saying that,
- under the class system any discussion of ethics was meaningless; only when that system has been removed it will be possible to define ethics meaningfully
- even the term exploitation according to Marx, was only a description of social relations and not an ethical judgement

Marxism and OR

- in Chile in 1971 Stafford Beer conducted OR for the planning and operation of the economy of Chile when Salvador Allende was president
- the project received high-level support, OR teams were formed to analyse every sector of the economy and considerable progress was made in a short period of time, but had to end when Allende was killed in a fascist coup
- the experience in Chile demonstrated the potential of OR for running an economy without relying on market forces as Rosenhead at LSE had advocated

- in the 20th century Gramsci, Lukacs, Althusser, and the members of the Frankfurt School turned their attention from political economy to philosophy and humanism for the organisation of society
- the question remained however: how can any proposition be justified or validated; or as Kant puts it in his transcendental question: *"What are the conditions of the possibility of objective experience or knowledge and what can reason achieve when all experience is removed?"*
- this question was taken up by Habermas of the Frankfurt School; a group of Marxist thinkers who aimed to reinterpret Marxism
- the school incuded Horkheimer, Adorno, Marcuse, Benjamin and others, who developed what is now known as critical theory

critical theory of the Frankfurt School

- critical theory regards positivism as inadequate and misleading in developing a true conception of social life
- most scientists have long observed some type of positivism according to which: (i) the only true knowledge is scientific knowledge; (ii) such knowledge is free of values, and (iii) the inquiring subject can be separated from the object of inquiry – subject-object duality – so that objectivity is ensured
- Comte first defined positivism in sociology as recognising only social structures and facts and not the subjective understandings of individuals who make up the society

- much of OR today is still conducted within the positivist paradigm, often failing to deal with the power structures embedded in problem situations
- according to positivism, all true knowledge had first to be verified empirically by objective observation
- but the decision of what to observe, and in fact the whole research agenda is subject to the power structure and can never be objective
- hence positivism sanctions the present social order, obstructs change, and leads to political barrenness
- Horkheimer and Adorno of the Frankfurt School, thought Marxist analysis needed furter distancing from positivism and should cover more than economic factors; for example, class struggle should be replaced with philosophy and the claim of Enlightenment to reason should be questioned

- their theory payed attention to both explanation and criticism and therefore had both normative and explanatory features
- particular concern was the dominance of society by science and technology and the emancipation of men from the circumstances that enslave them
- in this respect they were inspired by Kant's aesthetics as well as by Marxism; but they differed from both
- Adorno's pupil Habermas has been the most influential member of the school as far as OR is concerned
- his aim has been to reformulate the project of modernity in terms of a universal pragmatic, a theory that retains the commitment to values of truth, critique, and rational consensus

- to do this, he rephrased Kant's transcendental question as follows:
  - *What are the conditions that constitute meaningful experience?* (This question is the a priori of experience, which requires a constitutive theory of experience that defines what experience is).
  - *What are the conditions that justify validity claims of propositions?* (This question is the a priori of argumentation, which requires a consensus theory of truth that defines the criteria of validation).
- he developed complex answers to these two questions that are directly relevant to systems thinking and OR

Habermas' theory of experience

- his answer to the first question is provided in his theory of cognitive interests, and the answer to the second in his theory of communicative action
- his premise is that human activity is guided by a search for knowledge; accordingly, he lists three types of cognitive interests and three types of knowledge:
  - technical interest seeking instrumental reason or knowledge
  - practical interest seeking interpretive reason or knowledge, to maintain mutual understanding among people
  - emancipatory interest seeking critical reason or knowledge that '*enables people to reflect on their situation and liberate themselves from domination by forces that they are involved in creating but that they cannot understand or control*'

- Habermas makes a distinction between what he calls the System and the life-world within which human life takes place
- the System is the social structure of production, finance and political power that is imposed on society by late capitalism
- instrumental reason guides instrumental action but also strategic action that creates the System
- the life-world on the other hand, is the unproblematic convictions about life, culture, society and human action
- if the System is the domain of instrumental reason, the life-world is the domain of all reason; instrumental, practical and critical

- under late capitalism instrumental reason has come to dominate practical reason; the media of money and power has commodified work, leisure and the arts, resulting in the colonisation of the life-world by the System
- problems of practice are now handled by experts using the methods of science; the result is that practical problems about what ought to be done are now handled by experts from science; ending up with a relentless technocratic domination
- Habermas believed that capitalism and democracy were no longer compatible *(I don't know if he still does..)*

1. instrumental action is directed towards the production of material goods and the functionalist systems approach of OR is based on instrumental reason
   - this is the optimisation based hard OR, the question to address is not ‘what to do’, but always ‘how to do’
   - strategic action, which also results from instrumental reason, is undertaken by power groups directed towards the preservation of power relations in favour of the present structure
   - which may not be easy to identify in problem situations
   - hence the functionalist approach of OR often overlooks this possibility and therefore is in danger of turning the inquirer into an expert

2. in general, the application of instrumental reason will produce practical consequences impacting human practice and social life
   - this is in fact why theory and practice are inseparable, as Marx said
   - the practical interest that seeks interpretive knowledge recognises that problems of practice are in fact, problems of ethics
   - the interpretive systems approach of OR is based on practical reason and addresses situations in which a unitary purpose is not possible,
   - it aims to prevent the detrimental effects of technical interest on human practice

3. the third cognitive interest is emancipatory; that is concerned with asymmetries of power and the governing mechanisms of the System as well as the damages and distortions this creates in the life-world
   - the emancipatory systems approach of OR seeks to address such problem situations
   - clearly these three perspectives on human life were each the subject of the three volumes of Kant
   - in OR, Churchman, Ackoff, Checkland and others, rather than accepting the narrow rationality of hard OR, recognised that human decision making was more complex and governed by other than economic values

- soft system methodologies, or soft OR, such as that of Checkland's SSM sought to adress these practical and the emancipatory interests and derived its outlook from Husserl's phenomenelogy (that concerns itself with men's thinking about the world rather than the world itself) as well as from critical theory
- Checkland proposes that a full consensus of views is not necessary, and a mutual accomodation may be sufficient to bring about common action
- soft OR methods may work in some cases, but so long as power asymmetries persist, they end up with keeping capitalism manageable and excluding the mass of people from power

Habermas' consensus theory of truth

- with regard to the second part of Kant's transcendental question, Habermas proposes his theory of communicative action that adresses validating propositions of truth and propositions of rightness
- hence his consensus theory of truth deals with theoretical discourse, and his consensus theory of rightness deals with practical discourse
- meaning that validity claims such as truth or rightness can only be settled discursively by some sort of consensus
- settling such claims effectively will be possible through what he calls communicative reason that enables the preservation of the validity of the life-world

- Habermas develops a set of conditions that would ensure communication to be free from the constraints of strategic action or an unequal chance of expression
- even if these conditions may not be satisfied in practice, they would represent an idealised measure, what Habermas calls a perfect speech situation in which participants are free and have equal opportunities to participate in the discussion
- it can then be used as a benchmark to identify situations where unequal participation in discourse or unequal distribution of power create a false consensus
- Checkland's SSM that seeks committment for common action, represents an attempt to operationalise and bring about exactly such a perfect speech situation

pragmatism

- Habermas's aim has been to reformulate the project of modernity in terms of what can also be called universal pragmatics
- the term 'pragmatic' is misused in everyday language in the sense of being selfish and unprincipled; whereas pragmatism is a philosophical school that calls for a comprehensive and ethical critique of all consequences of human action on those affected
- Peirce's famous maxim defining pragmatism: *Consider what effects that might conceivably have practical bearings you conceive the objects of your conception to have. Then, your conception of those effects is the whole of your conception of the object.*
- actually summarises the basis of systems thinking in OR

- pragmatism rejects the idea that the function of thought is to describe reality, instead
  - the function of thought is to act as an instrument or tool for prediction, action and problem solving
  - any conclusions about facts, theories or aims must be subject to re-evaluation in the light of facts
- pragmatic ethics focuses on how research findings should consider the range of stakeholders affected and should equally weigh the consequences to all those affected

- philosophical pragmatism has a long history in OR
- Churchman (1913–2004) and Ackoff (1919–2009) based their approaches to OR on pragmatist thinking as taught to them by their teacher Edward A. Singer, Jr
- Churchman wanted to place moral considerations at the centre of OR
- not surprisingly, his proposals were rejected by the American OR community who were engaged in solving instrumental questions using hard OR techniques, with no regard to social consequences
- Werner Ulrich, a doctoral student and research colleague of Churchman, drew on both Churchman and Habermas to develop his critical systems heuristics

industrial engineering

- OR has been adopted by the industrial engineering community and now provides its theoretical backbone
- most OR is now practiced by industrial engineers, but often restricted to the narrow domain of engineering where it loses much of its broader, systemic outlook
- engineers are primarily concerned with designing and implementing instrumental action to achieve predefined ends, ie. with answering the ‘how to do it’ question
- at the same time, with their knowledge of what is practically feasible, they are often involved in defining those same ends

- hence pragmatism is inherent in their day-to-day activities, but the philosophical foundations of engineering are often left undiscussed
- losing the wider, systemic outlook of OR has started in the 80s under full scale neoliberalism which professed that all significant choices in human practice sould be decided in markets by market forces
- which meant actually, by a very small minority who has accumulated and still continues to accumulate immense market power
- but this situation is now rapidly becoming unfeasible and unsustainable; what with the never ending recession of 2008, diminishing resources, environmental collapse, mass migrations and the devastations of climate change
- the need to return to true OR may now be gaining urgency

Some references:

- Ackoff, R. (1979) The future of operational research is past. *JORS, 30,*
- Checkland, P. (1981) *Systems Thinking, Systems Practice,* John Wiley & Sons
- Churchman, W. (1970) Operations research as a profession, *Man Sci, 17*
- Churchman, W. (1979) *The Systems Approach and its Enemies*, Basic Books
- Dando, M.R., Bennet, P.G. (1981) A Kuhnian crisis in management science, *JORS, 32*

- Güven, Ç. (1999) Operational Research from a Critical Viewpoint, *17th International Conference of the Systems Dynamics Society,* (*Available at* *http://sistems.org/caglar_guven_yazilari.htm*)
- Güven, Ç. (2006) Underlying Theory for Systems Thinking, *class notes available at http://sistems.org/caglar_guven_yazilari.htm*
- Ormerod, R.J. (2020) Pragmatism in Professional Practice*, Systems Research and Behavioral Science,* August
- Ormerod, R.J. (2017) The history and ideas of Marxism: the relevance for OR, *JORS, 59*

- Rosenhead, J. (1989) Introduction: old and new paradigms of analysis. In Rosenhead, J. (ed) *Rational Analysis for a Problematic World*, John Wiley & Sons
- Ulrich, W. (1983) *Critical Heuristics of Social Planning: A New Approach to Practical Philosophy,* John Wiley & Sons
- White, S.K. (1988) *The recent work of Jürgen Habermas,* Cambridge University Press