A SOCIO-SCIENTIFIC THEORY OF CONTINUOUS MACHINES

MASUDUL A. CHOUDHURY*

SUMMARY: The paper considers a general theory of systems in a process-based framework whose epistemology is unity of knowledge. The process of reflecting the unity in the socio-scientific order is carried out through the medium of unification of knowledge. The methodology for such a process-centred world view is formulated and scientific evidence of its viability in the general systems framework is presented from secondary sources.

Key Words: Socio-Scientific, socio-economic.

INTRODUCTION

Firms and institutions are today experiencing continuous technology change and replacement of equipments. This rapid change causes problems of social adjustment due to gaps between technological change and the social requirements of technology. The emerging problems cause both private as well as social costs to occur. These together intertwine to increase the total cost of machines and equipments in the sense of enterprise, economy, society, institutions and the human ecology, all interacting with each other on socio-scientific grounds. For instance, the rapid expansion of medical technology has not lowered the unit cost of medical care or broadened its accessibility to all users generally. In developing countries, the import bills associated with such expensive medical technology have been staggering. OECD points out, that medical expenditure remains the highest next to expenditure on public education in industrialized countries, not to speak of the developing ones who are at the receiving and of technological change, its transfer and import (OECD 1984).

THE CONCEPT OF THE SOCIO-SCIENTIFIC PHENOMENA

The idea of socio-scientific phenomenon is to discern interrelationships among science and society, technology and society, and hence between machines and society, in an interactive way. Thus by a socio-sci-

---

*From Department of Economics, School of Business, the University College of Cape Breton Sydney, Nova Scotia, Canada.

entific theory here we will mean a unique methodology for analytically discerning, extracting and using interactions among all systems, e.g. interactions between machine systems and socio-economic systems. It is surmised in this paper, that such an interactive approach can be derived epistemologically from and can then establish a unified ethical perspective in science and society. We claim that such a methodology premised on a unified way of looking at systemic interrelationships cannot be possible in a disjointed and dualistic view of general systems, when these are governed by mutually independent epistemes.

THE CONCEPT OF MACHINES

Let us now explain our concept of machines from which the idea of continuous machines can be derived. We will define machines as technological instruments that are subjected to the idea of socio-scientific phenomena as studied by means of a unification theory of systemic interactions. A machine is therefore an instrument that carries with it a body of scientific and technological knowledge that manifests the epistemological basis of the corresponding theories in human situations. Many elements characterize such human situations. One such situation is human ecology (12). It includes broadly, sub-systems such as, health, society, economy, economic activities such as production, consumption and distribution, etc. Human ecology also spans a study of markets of all kinds. Thus enterprise, skills and formation of consumer preferences based on the background of economic activities, also belong to the domain of human ecology. Like this, many other social sub-systems can be included.

Consequently, private and social costs as well as private and social benefits arise from interactions among the above types of activities via the medium of machines as instruments of scientific and technological epistemes. Machines as such inter-systemic instruments become a powerful connector between science, technology and the socio-economic order. The study of the precedent and consequentialist contexts of machines is therefore, of immense importance in restructuring private and social costs and benefits in society that engender either due to the gap or due to complementarity between science, technology, machines and social requirements, respectively.

Continuous Machines

Now we turn to define continuous machines. Here we consider the nature of machines as instruments when the science-technology socio-economic interrelationships, i.e. socio-scientific interrelationships, become continuous in nature. By viewing socio-economic change as a continuous phenomenon, the socio-scientific system of interrelationships becomes continuous as well. Consequently, machines as instruments that are intrinsically linked to socio-scientific changes, can remain effective carriers of an underlying scientific and technological episteme and define the continuous chain of interactions, if they are viewed as continuous machines.

Hence a continuous machine is a technological and scientific instrument that enables continuous socio - scientific interactions to occur and be explained in the background of the unification theory of general systems. We will introduce such a unification methodology and explain the nature of extensive socio-scientific interactions that are realized in general systems involving machines as continuous instruments of change. In this sense we note, that just as policy instruments can impart continuous effects on socio-economic variables, so also now continuous machines become socio-economic and instrumental entities, even though they preserve their physical identities.

OBJECTIVE

Our objective in this paper is to present a modular theory of continuous machines incorporating in it a unique analytical theory interlinking science, technology, machines and society. Using such a theory and the continuous nature of interrelationships bet-ween machines as socio-scientific instruments and the socio-economic order, we will show that our emerging socio-scientific theory can provide an ethical meaning to science, technology and machines in relation to the socio-economic order.

We will use first a genetic control instrumentation as molecular machines and consider them in terms of human factor. We will show that in actual experiments carried out with molecular continuous machines, there exist extensive interactions and complementarities that oppose the Darwinian idea of conflict among groups of natural selections. Thus we will argue that in our unique modular socio-scientific theory of machines, continuous evolution of machines must be determined and evaluated in reference to interactive social decisions involving science, technology and society. These cannot be taken up independently of continuous machines will revolve around the theory of capital accumulation as perceived in the Austrian economic literature. Here we will show how institutionalization of complementary economic activities can negate the age-old claim of sensitive relationship between interest rate and capital formation. Instead, we will place capital formation in the interactive, consensual and dynamic framework of cooperative economic activities.

STATEMENT OF THE PROBLEM

We start axiomatizing that if machines and socio-economic systems are to be unified by a unique epistemology, there must prevail a unique body of knowledge of phenomenon in each of such systems. We will then deduce as a corollary, that conversely, the pervasive existence of such an embryonic systems-knowledge must neccessarily unify socio-scientific systems and all that are in them. This latter attribute by the principle of causation between systems and their agents and variables, would cause extensive complementarities among diversities of similar categories. Such a principle that unifies systemic entities by means of interrelating them, is referred to here as the Principle of Universal Complementarity. This principle is of critical importance in our understanding of the ethical context of socio-scientific systems.

By interconnecting general systems, diverse as they may seem, such as machines and the socio-economic order, we endogenize a unique knowledge in the unifying agents and variables within and across such systems and their sub-systems. Hence a unique methodology of unifying systems can be possible in terms of the commonly endogenizing knowledge input and output. A socio-scientific model of knowledge-induced interrelationships emerges (4). The extensive nature of complementary interrelationships across systems now defines the idea of general systems.

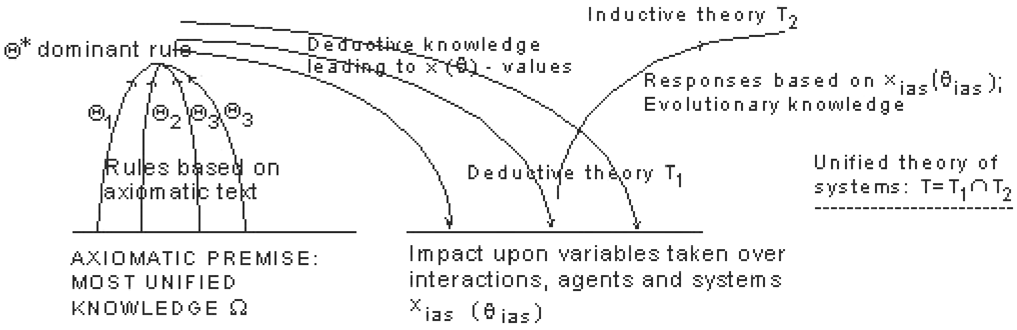
Furthermore, since a continuous and evolving nature of causation must exist between machines and the socio-economic order, therefore, the pervasively interactive model of knowledge in socio-scientific systems must also be of an evolutionary type. A learning process in systems is thus implied. Optimal states of independent systems and of exogenously induced technologies and scientific methods, which are really conveniences mechanized by humans but may not be realism, are replaced by inherently evolutionary processes (13,24).

Finally, we note the following additional property of the knowledge-induced model. Due to the learning process reflected by interactions and systems evolution, stages of convergence across certain ranges of interactions occur. Such stages are marked by evolutionary equilibria pertaining to the diversity of paths that lead to the convergence points (22). Such temporary equilibrium points exist only in the instantaneous sense. They are immediately perturbed by fresh knowledge induction of the socio-economic variables, included in which are continuous machines existing as instruments.

Hence interactions occur. They lead to temporary knowledge-induced integration or convergence. Integrative states are subsequently evolved to higher (or lower) levels of newly and inductively regenerated knowledge. Such a learning-by-doing experience in knowledge production and the socio-scientific order, proceeds on continuously.

We will now collect the above three stages of the knowledge-induced modular forms, namely, interactions, integration and evolution in Figure 1. We will call

Figure 1: The Interactive-Integrative-Evolutionary Knowledge-Induced Theory of General systems.



this model as the IIE-model. The IIE-model implies that a unique system must generate a theory, say T, out of two complementing partial theories, say T_1 and T_2 according to diversities of each other. Thus, $T=T_1 \cap T_2$.

Formalization with Interactions, Integration and Evolution in Knowledge-Induced Systems

In order to look more closely in terms of the knowledge-values and their knowledge-induced socio-economic variables, we proceed as follows: Let, $\{\theta_{1as}, \theta_{2as}, \ldots\}$ denote the sequence of knowledge-vectors, θ_{ias} with interactions i=1,2...., agents a=1,2,..., systems s=1,2,... Let the knowledge-induced socio-economic variables be denoted by, $\{x_{1as}(\theta_{1as}), x_{2as}(\theta_{2as}), \ldots\}$, where, $x_{ias}(\theta_{ias})$, i, a, s are as defined above. The vector-variables are differentiated by ranges of interactions leading to temporary convergences followed by their evolution.

We can write T_1 and T_2, hence T, as follows:

$T(\theta_{ias},\theta_{ias}'), x_{ias}(\theta_{ias}), x_{ias}'(\theta_{jas}')) = T_1(\theta_{ias},x_{ias}(\theta_{ias}))$ o $T_2(\theta_{jas}',x'(\theta_{jas}),\{\theta_{ias},\theta_{jas}',\ldots\} \in \Omega$. i,j=1,2,..., i and j depend upon the limiting value of interactions within given stages and are not necessarily equal. Hence θ-values and θ'-values; similarly, x(θ)-values and x(θ')-values, are not necessarily equal in their categories. In Figure 1, the θ*-value stands for the limiting case of the vector of θ-values. It is associated with a dominant rule selected out of complementary rules that emerge from the axiomatic premise by virtue of the latter's unification power in theoretical and practical sense. Thus, corresponding to θ*, there emerges a dominant theory combining deductive and inductive reasoning. The latter two interact together by means of cause and effect (necessary and sufficient relations) to give the dominant unification theory of systems, T, as shown.

'o' denotes composite mapping between deductive theory, T_1, and inductive theory, T_2. Hence, due to the circular causation of inductive and deductive processes being interlinked in the above-mentioned theory of general systems, a unique theory, T, is established by a continuously composite functional of evolutionary epistemologies of systems integrating together in the deductive and inductive processes. The above type of theory construction applies to all agents and systems. Here, i=1,2...; a=1,2,...; s=1,2,..

We note from the simulative dynamics of the causal processes, Ω to T_1 and T_1 to T_2, shown in Figure 1, that the composite functionals, such as T, are endogenized in the circular causation and continuity model x-values are knowledge-induced. Both θ-values and x-values are evolutionary in nature, but they proceed in processes (i.e. from interactions to integration to evolution). In this way, the evolutionary processes unify across a=1,2...; s=1,2,..., in terms of the regenerated circularity of q-values and their interrelationships with knowledge - induced x-values.

It remains to be seen whether the rule of IIE-model emerging from the θ-values is of the nature of complementarity or of marginalist substitution. The latter pervades neoclassical economic theory and its protoypes (11). If this latter property holds, marginalism between alternatives in systems and among agents will continuously individuate the processes, T_1, T_2 and their like, until methodological individualism prevails across all a, s. The idea of marginalist substitution found in neoclassical theory of economics, society and science (5) is the product of self-attenuating concepts, such as, of duality, pluralism, independence and individualism, optimality and steady state equilibrium, plus a linear concept of time governing change in the absence of knowledge induction. As opposed to the linear concept of time we have Kant's transcendental (1) and Einstein's simultaneity problem in time and event (8). None of the self attenuating concepts mentioned above, can cause complementarity between T_1 and T_2, although within T_1 and T_2 there can exist continuous states defined by physical and social Darwinism. The implication here is that the 'dynamics' of marginalist substitution as a neoclassical principle within systems, leads endogenously (that is in its own conceptual plane) to the states of non-complementarity across systems of its own prototypes.

In order to generate 'global' complementarity, both within and across systems, θ-values and x-values are premised on Ω that epistemologically axiomatizes general systems. Such an essence of uniqueness and extensive complementarity across agents and systems in the IIE-sense, is the meaning of unity in general systems. The methodological transmission of this unity attribute in the θ-induced theory of general systems attains the idea of systemic unification.

In the academic literature, such a textual unification epistemology is found in the ideas of unity of the sciences (20), theories of everything (2), and global ethics (6). A very interesting case of unification epistemology was given by Ghazzali's theory of Divine Knowledge and its impact upon the world (16). Ghazzali's concept of T being a composite between T_1 and T_2, is contrary to the solely deductive theory of systems given by Kant (T_1) (15) and the solely inductive theory given by Hume (T_2) (14).

THE TOPOLOGY OF KNOWLEDGE IN THE IIE-MODEL

Because any $\theta,\theta\sim\in\Omega$, therefore, $\theta\cap\theta\sim\in\Omega$. The mathematical complementation of q is denoted here by $\theta\sim$, with $\theta\sim\in\Omega$. Thereby, $\theta\cap\theta\sim=\phi\in\Omega$, and $\theta\cup\theta\sim\in\Omega$. Furthermore, since in Figure 1, θ's generated from Ω, therefore, there exists a measure that is definable over Ω (9). This however, does not mean that Ω is measurably closed, for then, for example, Ghazzali's concept of divine unity and its relationship with the world, would not be well-defined. Thus with the above properties, Ω becomes a higher dimensional extensive topology. Such extensions can be defined by the Hahn-Banach algebras (19).

In Ω, non-null intersections, $\cap$, denote interactions. Null intersections, $\cap$, denote the absence of interactions. Hence, since θ-values $\in\Omega$ define paths based on unification, that is complementarity out of diversity, therefore, $\theta\sim$-values $\in\Omega$ denote paths of marginalist substitution. The latter are necessary in the parent topology in order to affirm the existence of θ-induced paths as signified by the evolution of θ-values and of their corresponding knowledge-induced socio-economic variables, the $x(\theta)$-values. The disjointness between paths dependent upon θ-values and $\theta\sim$-values proves the complete polarity between unity-based 'global' complementarity and the idea of marginalist subsitution (tradeoff). The two socio-scientific paths provide polar forms of relationships between continuous machines and the socio-economic order. We will now particularize the socio-scientific meaning of Figure 1 to the case of continuous machines and their relationship with the socio-economic order.

THE INTERRELATIONSHIPS BETWEEN CONTINUOUS MACHINES AND THE SOCIO-ECONOMIC ORDER

In Figure 2, the axiomatic premise of continuous machines in the socio-economic order, i.e. s=1 (machine), 2 (socio-economic order), 'a' being given, comprises the circular causation and continuity model of unified reality for the socio-scientific theory as provided by Figure 1. Thus, a machine and a socio-economic order that are both epistemologically premised on such a unification model (IIE-model), provide a universally complementary world view for similar categories. Thereby, this unique theory (T) becomes universally the socio-scientific theory of continuous machines (s=1) and the socio-economic order (s=2).

Now a machine (or socio-economic order) set up in two different positions, P_1, P_2, in Figure 2, giving rise to conceptual rules α_1, α_2, respectively, will still generate a uniquely unified theory. The respectively knowledge-induced observations based on these rules, i.e. $x_1 (\theta_1(\alpha_1))$, $x_2 (\theta_2(\alpha_2))$, though different due to diversities, will be functionally linear (or monotonic). Thereby, say, $x_2 (\theta_2(\alpha_2)) = q.x_1 (\theta_1(\alpha_1))$, for which the cost generated for $x_1(.)$, say $C_1(x_1(.))$, is monotonically related to the cost for $x_2(.)$, say $C_2(x_2(.))$. Likewise the socio-economic benefits generated remain monotonic as well.

Now, $C_2(.)= q.C_1(.)$, $C_3(.) = q^2.C_1(.)$, etc. $C_n(.)=q^n. C_1(.)$. Let, $C_1(.)= C_o(\theta_o)$.

Thereby, the total cost associated with the machine-socio-scientific operations is denoted by,

$C(\theta)= \sum_{t=1}^{n}C_t(\theta)=C_o(\theta_o)/(1-q)$, $q<1$.

As shown earlier, diversities of α's and hence of θ's, but always functional linearity or monotonicity of x's and T's, cause socio-scientific values, $(\theta,x(\theta))$, to increase. Diversities in paths and possibilities in this sense, result in risk-diversification, which causes $C(\theta)$ to decline, q being given. Hence, this total cost declines with increase in θ-values.

THE IDEA OF SOCIAL 'POSITIONING' OF CONTINUOUS MACHINES

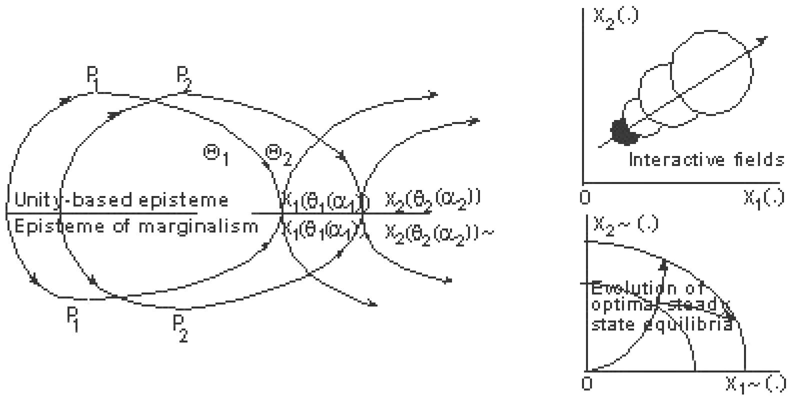
A prominent implication of such a phenomenon of cost reduction with increase in biodiversity, is the relevance of alternative medicines for social well-being. The complementarity between biodiversity and community-based medicine was recognized in the Rio-Earth Summit (17). Now by means of the social appropriateness concept and its cost-reducing and risk-diversifying consequences, we come across the term, social 'positioning' of continuous machines. This concept is taken up in the light of the social requirements that such alternative social positions can gene-rate to make biological instruments (machines), and hence the underlying scientific and technological epistemology, socially acceptable. The diversity of alternatives generates ways of understanding this idea of social 'positioning' of machines (medicines, medical instruments, genetic control, molecular machines etc.).

In Figure 2, the social 'positioning' concept is displayed by the points like P_1, P_2, etc. If now we reverse the relations by premising P_1, P_2, etc. on the epistemology of marginalist substitution (tradeoff) between machines and between machine and their social requirements, and then carry on the arguments as given above for the case of θ~, then $x_1(\theta(\alpha_1))$~ and $x_2(\theta_2(\alpha_2))$~ are not monotonically related. Here the ~ affixed to variables indicates mathematical complementation (opposites) of the knowledge values and their induced socio-scientific values including machines.

In the complementation state or the 'de-knowledge' case, it is noted that even if we induce technological change in the marginalist (tradeoff) system, no structural difference is realized. Such a change merely enhances θ_1~ - values by virtue of their theory of endogeneity according to the self-same marginalist substitution (tradeoff) property. We therefore say, that neoclassical systems both of science and society, borrow exogenous technology and preference, and the endogenously perpetuate such exogenous properties. Only recently, endogenous growth models have commenced to be studied in the light of their property to annul the assumption of diminishing marginal rates of return in production functions. Endogenous growth model attain this feat by the production of knowledge in their system. Yet by and large, the properties of such models remain to be those of well-behaved neoclassical production menus (26).

The choices of $x_1(.)$~ and $x_2(.)$~ necessitate the existence of opportunity cost. Contrarily, opportunity cost did not exist for our case of extensive complementarity between $\theta_1(x_1)$, $\theta_2(x_2)$, $x_1(\theta_1(\alpha_1))$, $x_2(\theta_2(\alpha_2))$, etc.

Figure 2: Effects of Shifting 'Positioning' of Continuous Machines.



Since marginalism of any one choice against another increases its opportunity cost, therefore, risk and uncertainty, hence transaction costs, increase in the system. Figure 2 thus addresses both the case of knowledge-induced socio-scientific theory of continuous machines as well as the neoclassical type theory of marginalist machines in the socio-economic order. Examples of the latter types respecting the social 'positioning', are socially costly and non-adaptive machines, rapid obsolescence of machines, and technology, and harmful effects caused by such optimal machines, that unlike those generating complementarities with diverse possibilities, are costly to control.

The following is the principal difference between P_1, P_2 etc. in Figure 2, in the two cases of unity-based episteme and marginalist episteme: The IIE-model world view is premised on a process model of evolutionary epistemology arising from strong and pervasive interactions and integration in knowledge-induced general systems. The IIE-character unifies alternatives by its Principle of Universal Complementarity and thus diversifies risk and costs with the complementary social 'positioning' of continuous machines. The model of marginalist substitution is caused by cost increases associated with different social 'positioning' of machines. Such positionings are considered to be optimal and equilibrium states in the sense of steady state conditions or at best being endowed with limited process characteristics (7). While the IIE configurations of machines in the diverse social 'positioning' lead to cost and risk-diversification via the principle of universal complementarity, optimal machines lead instead, to costly control mechanism. Failure in achieving the latter states leads to social costs generated from lack of optimal control of the machines. Such effects in both the cases are continuous in the socio-economic order via continuous machines.

SOCIAL COSTS AND THE 'POSITIONING' OF MACHINES

In order to study the problem of social costs associated with machines in the light of the knowledge-based socio-scientific theory, we treat a machine in a community sense (a social sense) with respect to the interactions that are generated with the corresponding socio-scientific variables. Let the gamut of such interactions among the diversity of knowledge and rules governing machines and socio-economic systems in the sense of uniqueness of unification despite monotonicity among the rules, be denoted by $\cap_{ij}\theta_{ij}$, with i, j=1 (machines), 2 (socio-economic system). The corresponding interactions among socio-scientific variables are denoted by $\cap_{ij} x_{ij}(\theta_{ij})$, with i, j=1,2 as before. Likewise, we can have the $\theta\sim$-values and their corresponding $x\sim$ socio-economic variables.

Examples of variables included in the above kinds are social 'positioning' of continuous machines for the two cases-of complementarity and marginalism, as knowledge and de-knowledge of the machine types in these two cases, respectively. In either case, the i, j-subscript denotes the two kinds of response from society on the appropriateness of the machines from the social point of view. On the side of socio-scientific variables are machine costs that are interrelated with social cost. In the latter type is the cost of human exposure to x-ray caused by the problem of appropriate social 'positioning' followed by the corresponding social responses.

Some of the interrelationships among Θ_{ij} and $X_{ij}(\Theta_{ij})$ can be shown in the matrix given below:

$$\begin{array}{lcc} \theta_{ij} \quad i & 1 & 2 \\ \hline j & & \\ 1 & \theta_{11} & \theta_{12} \\ 2 & \theta_{21} & \theta_{22} \end{array} \quad \rightarrow \quad \begin{array}{lcc} Xij \quad i & 1 & 2 \\ \hline j & & \\ 1 & X_{11} & X_{12} \\ 2 & X_{21} & X_{22} \end{array}$$

With the above kinds of interactive variables, we can now provide the mathematical definition of continuous machines (M) in terms of such interactions between machines as socio-scientific instruments and the gamut of socio-economic variables:

$M = M(\cap_{ij}\, \theta_{ij}, \cap_{ij}\, X_{ij}(\theta_{ij}))$, i, j=1,2.

The important point to note in the above mathematical definition of continuous machine is the delineation of a machine as an instrument of interrelationships among socio-scientific variables. This social configuration as a relational concept has been referred to in this paper as social 'positioning' of continuous machines. In this sense of the term, a machine is seen to be much more than a simple equipment. In fact, it is the social worth of the machine as a socio-scientific instrument that establishes its meaning and appropriateness.

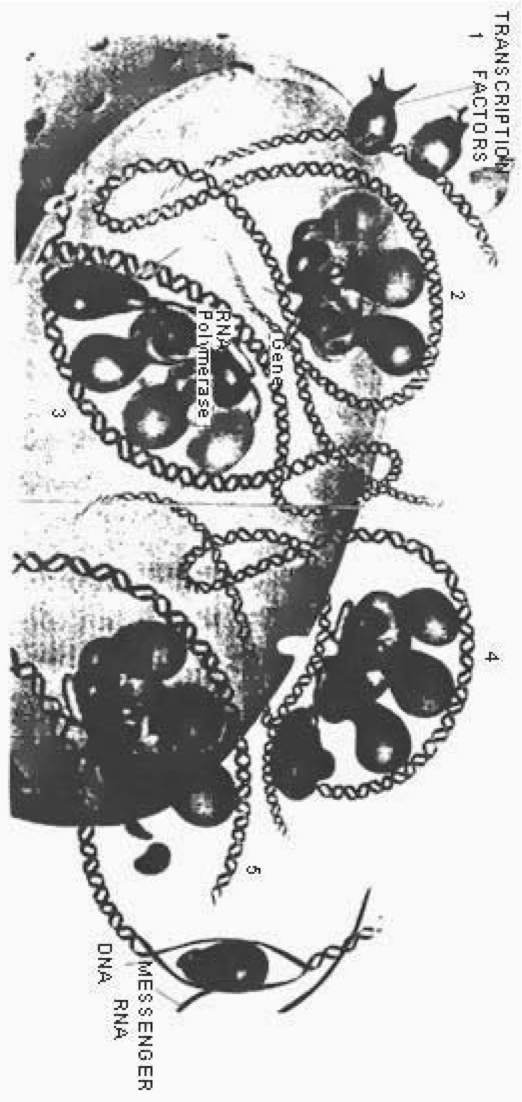
In this case, the interactions among θ_{ijl} and $X_{ijl}\,(\theta_{ijl})$, i=1 (machine), 2 (socio-economic system), j=1 (machine), 2 (socio-economic system); l=1,2,3 (phases), become complex. So also the corresponding interactions shown by $x_{ijl}(\Theta_{ijl})$ become complex. The important point to note however, even beyond analytics, is the process orientation now generated among science, technology, machines, agents and society across stages of their evolution in order to determine appropriateness of technology and machines. Here the actual choice and social 'positioning' of machines as socio-scientific instruments requires social decisions pertaining to them. In such social decision-making, large sets of variables interact. Such interactions are most effectively captured by actual human participation on the issues at hand.

THE RELATIONSHIP BETWEEN KNOWLEDGE AND TIME IN CONTINUOUS MACHINES

On examining the epistemological meaning in the interrelationships between θ and $x(\theta)$ in relation to Ω, we find that time (t) is also a cognitive form among so many others in $x(\theta)$. Consider what would be the result if t was solely primordial in nature t would then precede θ and thus characterize the latter by its own property. In the real world phenomenon, the nature of time is monotonically linear and an independent variable. Thus, no substantive evolution would be possible. This is well known to be the ethical predicament of neoclassical concept of time and its created socio-scientific order (18). This problem of non-interaction in the 'global' sense of general systems remains even in stochastic control, once adaptive Markovian processes among random terms are invoked to linearize the uncertainty. Otherwise, non-controllability of systems due to their epistemologically un-unified and chaotic nature, would result in complexity (10). Neither of these two cases provides the properties of knowledge-induced systems commencing from the epistemology of unity and structuring a world that is controllable by the endogenous induction of such knowledge amidst diversities, complementarity and evolution.

Hence, $t=t(\Theta)$. But since Θ is essentially equivalent to interactions, which occur in the real space (continuous) or in the number system (discrete) along a positive direction, therefore, the simultaneity among

Figure 3: Transcription of Knowledge in Genetic Control.



MOLECULAR MACHINERY that regulates the activity of protein-coding genes consists of more than a dozen subunits known as transcription factors. Those subunits, which can each include many proteins, are shown assembling on a gene in stages (membered).
The finished complex (4) controls the rate at which the enzyme RNA polymerase begins to carry out a central step in protein synthesis (5) - the transcription, or cropying, of DNA into messenger RNA.

knowledge, event, and time must coexist. In the case of continuous machines, it is to be noted that such machines acquire meaning only in the presence of interactions, integration and creative evolution at given points in time (IIE). But a machine could alternatively exist at a point in time without such interactive properties. Such a machine would be of no interest to knowledge centered socio-scientific theory of continuous machines. Because of the simultaneity among knowledge, event and time, we take the real-valued time to be linearly and monotonically determined by knowledge with respect to a machine. Process-oriented simulation of socio-scientific machines then proceed on by means of simulating θ-values. Once again, beyond ordinality of θ-values for engineering systems, the more important note here is that of social participation in determining the appropriateness of technology and machines.

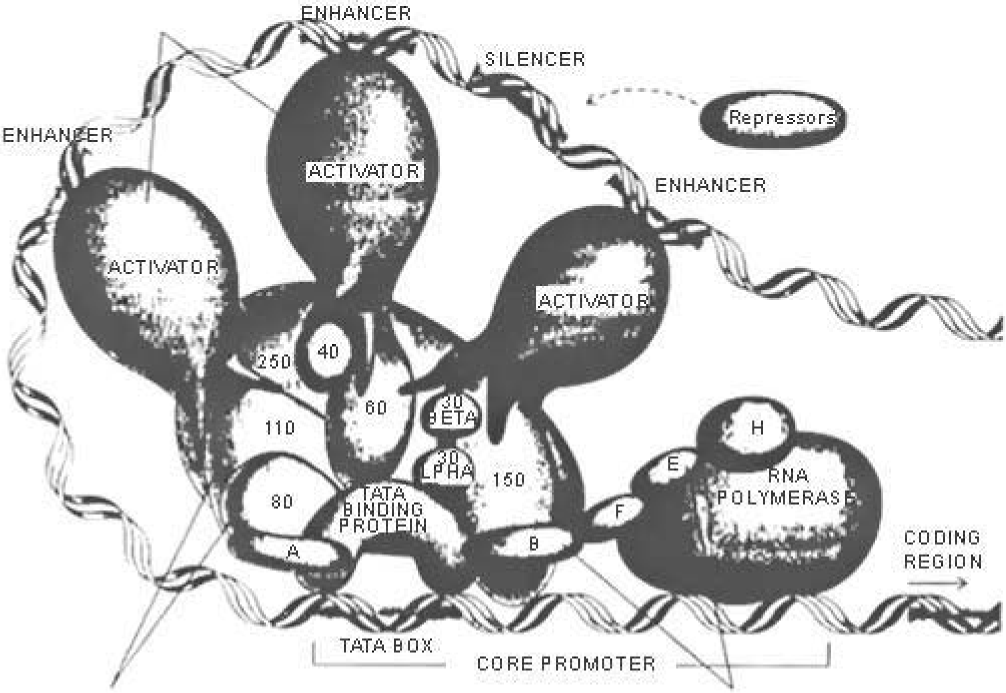


Figure 4: Molecular Machinery as Continuous Machine in Genetic Control.

ACTIVATORS
These proteins bind to genes at sites known as enhancers. Activators help to determine which genes will be switched on, and they speed the rate of transcription.

REPRESSORS
These proteins bind to selected sets of genes at sites known as silencers. They interfere with the functioning of activators and thus slow transcription.

COACTIVATORS
These 'adapter' molecules integrate signals from activators and perhaps repressors and relay the results to the basal factors.

BASAL FACTORS
In response to injuctions from activators these factors position RNA polymerase at the start of the proteincoding region of a gene and send the enzyme on its way.

Anatomy of the Transcription Apparatus:

The moleculer apparatus controlling transcription in human cells consists of four kinds of components. Basal factors, generally named by single letters, are essential for transcription but can not by themselves increase or decrease its rate.That task falls to regulatory molecules known as activators and repressors; these can vary form gene to gene.Activators, and possibly repressors, communicate with the basal factors through coactivators-proteins that are linked in a tight complex to the TATA binding protein (TBP), the first of the basal factors to land on a regulatory region of genes known as the core promoter. Coactivators are named according to their molecular weights (in kilodaltons).

EXAMPLES OF CONTINUOUS MACHINES AND THEIR SOCIAL 'POSITIONING'

1. Molecular Machines of Genetic Control

Continuous machines have their applications both within the epistemology of scientific systems as well as these in relation to the unique theory of socio-scientific systems embedded in socio-economics. We will support this claim first, by referring to the example of 'molecular machines' in genetic transcription (25).

The theory presented is that RNA polymerase emanating from a DNA base is monitored by a series of machine-like controls. These controls are provided by transcription proteins that activate proteins in cells. Such transcriptors that exist all through the various parts of the DNA proteins and effect extensively the whole systems, are linked also to enhancers and silencers that together act as smooth conveyors of the transcription effects. There is a sequence of co-activators that in conjunction with the activators, cause integration to take place among the messages coded by the activators. From such coding of messages arise genetic elements in the form of discrete sequences of nucleotides that control the ability of the RNA polymerase to transcribe messages. The totality of such genetic elements that establishes the RNA coding as the final output of the previous exchange of messages, is called the core promoter. While the activators comprising the transcription bases of molecular machines are linked with the co-activators, they are also linked to enhancers and silencer proteins.

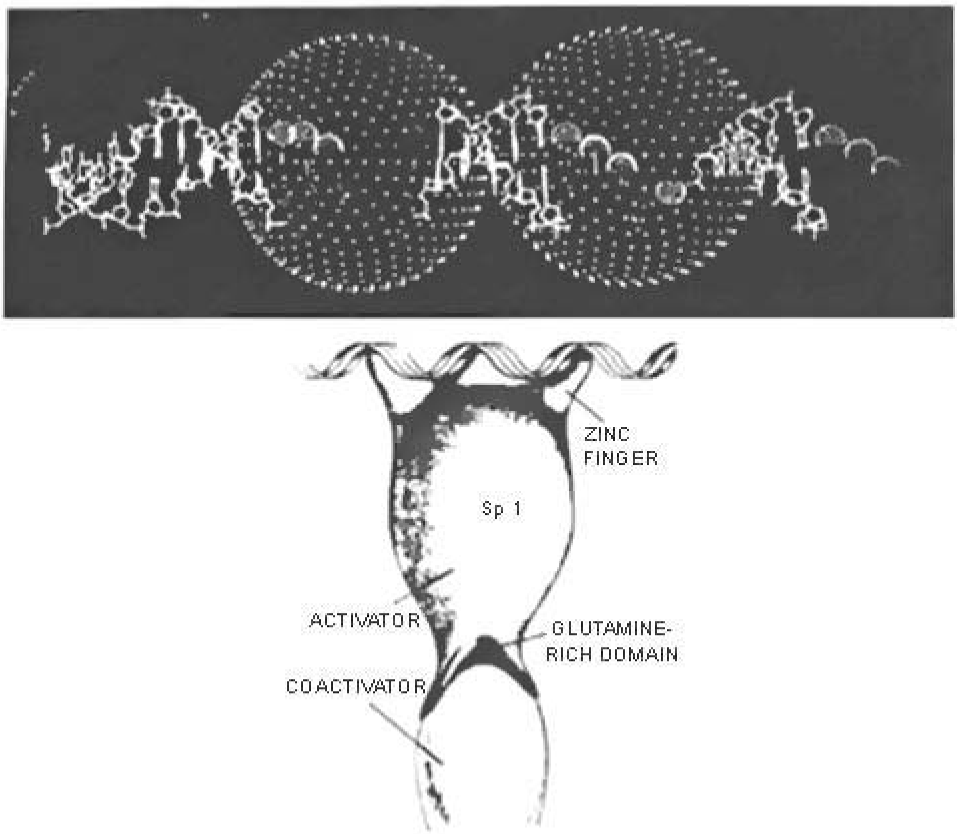
The above functions of molecular machines in genetic control is explained in Figures 3 and 4. Figure 3 shows the inner structure of any one of a sequence of molecular machines, and there are indefinitely many of these types over all kinds of proteins that interact with each other. Figure 4 shows the various parts of continuous machines within any molecular machine pertaining to an RNA polymerase. The important points to note in these genetic functions are first, to note the uniqueness of the transcriptor and its pervasiveness throughout all protein types during the phases of RNA polymerase. Second, the transcription rate of the RNA polymerase is conveyed by the combined activity of all proteins, i.e. by the transcriptor factors in the regulatory system from the start to the coding phase.

How do the sequences of interactive processes in molecular machines compare with the theory of interactions-integration-evolution (IIE)-model formalized in this paper for continuous machines and their social 'positioning' concept? To answer this question and explain, Figure 5 is specified as follows: A transcription is defined by gene-knowledge, θ. Its transcriptor factors are denoted by the sequence of derived gene-knowledge, $\{\theta_i\}$, i=1,2,3 (as shown in Figure 3). These knowledge-transcriptors cause a regulatory function in gene-control process to generate the knowledge-induced output, $x^*(\theta^*)$ - the RNA polymerase associated with the interactions and integration among the $\{\theta_i\}$-values and their intermediate forms, such as, proteins. The core promoters as conveyors that realize the interactions and integration in the genetic control system in this way, are of the form of $f(\theta_i,x_i(\theta_i)$-functionals. The coding process at the end of the interactive-integrative process in genetic control is of the type of $f(\theta^*,x(\theta^*))$functional.

The 'enhancer sequences' of Figure 5 that interact with each other in the region within the spherical spaces are like the evolutionary knowledge-induction causing complementarity between the deductive and inductive processes of knowledge formation and their cognitive impacts. Thus, such regions establish the IEE-regions over flows of knowledge as unification processes $\{\theta_i\}$ leading to θ^*-values and their cognitive forms, $x_i(\theta_i)$-values and $x(\theta^*)$-values, respectively. The base of such transcriptors is the most unified epistemology of transcription in genetic control. Throughout the above- mentioned theory of molecular machines in genetic control we find pervasiveness of the principle of universal complementarity, as the transcription rate is dictated by the combined activity of all proteins - or transcription factors - bound to its various regulatory elements.

Figure 5 can be easily compared with Figure 2 to summarize all the parts of the knowledge-induced IIE model that so cogently fit into the molecular machines of genetic control as continuous machines. It is also noted that the pervasiveness of systemic complementarities negate the marginalist substitution model of the neoclassical genre, which is also shown in Figure 2. The similarity between the socio-scientific epistemology of the IIE-model presented in Figure 2 and the same represented in the theory of molecular machines of genetic control, at once also universalizes the socio-scientific meaning of such a theory of molecular machine.

Figure 5: Explaining Interactions-Integration-Evolution (IIE)-model in Molecular Machines.



TWO MOLECULES of the activator protein Sp1 (represented above as large dotted spheres) have each attached to enhancer sequences called GC boxes by mean of protrusions known as zinc fingers; the points of contact with DNA are highlighted by orange hemispheres. After Sp1 grabs on to DNA, it uses a region rich in the amino acid glutamine to convey transcription-stimulating signals to a specific coactivator.

Molecular machines as continuous machines following the theory of IIE-model is thus a good example of unification of knowledge induction in socio-scientific systems. Tjian claims that the nature of genetic control by molecular machines is replicated in human genes as well. Thus with the application of the knowledge-induced IIE-model, we find that this uniquely applies to scientific systems and to human systems. The common message between them is knowledge input and output as transcription epistemology and unification of knowledge as transcriptor factors.

2. Application of Continuous Machine Theory to Capital Structure

There exist both resemblances and differences between Wicksell's concept of machines and ours. Capital to Wicksell is a relationship among a large number of dated commodities including labour (23). Furthermore, according to Wicksell the roundaboutness of production by expanding the interrelations among dated commodities, increases production and generates interest. This in turn causes more saving and more capital to occur (3).

Wicksell's dated commodities resemble the interactive nature of our continuous machines and society. However, through such interaction in our system, we found that risk-diversification is realized. This reduces transaction costs.

Wicksell's expanded production time through roundaboutness, increases the rate of interest. This in turn increases uncertainity in the intertemporal sense. To overcome this problem while maintaining the principal role of interest rate in capital accumulation, Wicksell shortened the length of production to a year (27). Thus, Wicksell was forced to ignore the importance of continuous machines as a socially productive asset.

In our case, the length and pervasiveness of interactions leading to creative evolution, reduces transaction costs. This must necessarily cause interest rates to decline. Savings are now done not by the capitalistic means of ownership and conflicting labour-capital relationship. Rather, savings now occur by means of participatory instruments of financing. Continuous machines, as we have defined in terms of a knowledge-induced socio-scientific theory, are found to be precisely such kinds of assets that are formed through social participation and not by the Wicksellian and Austrian concepts of capital, output and interest rates.

CONCLUSION

In this paper we have extended the explanation and application of knowledge-induced socio-scientific systems established in detail elsewhere (5), to yet another important direction - the topic of continuous machines and their social 'positioning'. We have opened up a discourse on the idea of a socio-scientific theory of continuous machines. Machines, just as all scientific and technological devices, are shown not to be insulated from and immune to the broader socio-economic questions. This central issue of the paper has been addressed by introducing a uniquely common methodology for general systems incorporating science, society and machines as socio-scientific instruments. This study we have taken up in an analytical form of the knowledge-centered world view.

We have shown both by theoretical construct and empirical presentation, that the concept of continuous machines is primarily one of systemic interrelationships described by contingent states of nature describing the meaningful configurations of such interrelationships. Time-continuity concept is applied only as a resultant of the knowledge-event simultaneous positioning, and not as being primordial to knowledge in the first instance.

We hope that this paper will open up further analytical research in the socio-scientific theory of continuous machines using the epistemology of unification of knowledge and its extensively complementarity perspective of the knowledge-induced world view.

REFERENCES

1. Al-Azm, SJ : Kant's Theory of Time. New York, NY: The Philosophical Library Ltd, 1967.

2. Barrow, HD : Theories of Everything. Oxford, Eng: Clarendon Press, 1991.

3. Bohm-Bawerk, E Von : Capital and Interest: A Critical History of Economic Theory. Trans by W Smart, New York, NY: stechert, [1889], 1932.

4. Choudhury MA : The Unicity Precept and the Socio-Scientific Order. Lanham, Maryland: University Press of America, 1993.

5. Choudhury MA : The Epistemological Foundations of Islamic Economic, Social and Scientific Order. Six vols, Ankara, TŸrkiye: Statistical, Economic and Social Research and Training Centre for Islamic Countries, 1995.6. The Commission on Global Governance : Our Global Governance. Oxford, Eng: Oxford University Press, 1995.

7. Dawkins R : The Selfish Gene. New York, NY: Oxford University Press, 1976.

8. Einstein A : Relativity, the Special and the General Theory. Trans by RW Lawson, London, Eng: Methuen, 1954.

9. Friedman A : Foundations of Modern Analysis. New York, NY: Dover Publications, Ch 1, 1982.

10. Gleick J : Chaos: Making a New Science. New York, NY: Viking, 1987.

11. Gupta D : Epochs of Economic Theory. Oxford, Eng: Basil and Blackwell, 1987.

12. Hawley AH : Human Ecology, A Theoretical Essay. Chicago, Il: The University of Chicago Press, 1986.

13. Hull DL : Science as a Process. Chicago, Il: The University of Chicago Press, 1990.

14. Hume D : Treatise of Human Nature. Buffalo, NY:

Prometheus Books, [1739], 1992.

15. Kant I, : Groundwork of the Metaphysic of Morals. Trans by HJ Paton, New York, NY: Harper and Row Publication, 1964.

16. Karim F : Imam Ghazzali's Ihya Ulum-id-Din (Lahore, Pakistan: Sh Muhammad Ashraf Press, (Undated).

17. Keating M : Agenda for Change. Geneva, Switzerland: Centre for Our Common Future, 1993.

18. Khalil E : Kuhn, Lakatos, and the history of economic thought. International Journal of Social Economics, Vol 14, Nos. 3-5, pp 118-131, 1987.

19. Maddox IJ : Elements of Functional Analysis. Cambridge, Eng: Cambridge University Press, 1970.

20. Neurath O, R Carnap, C Morris et al. : Foundations of the Unity of Science. Chicago, Il: The University of Chicago Press, 1970.

21. Organization for Economic Cooperation and Development. OECD Observer, no 126. 1984.

22. Osborne MJ and A Rubinstein, : Evolutionary equilibrium. In: A Course in Game Theory. Cambridge, MA: The MIT Press, pp 48-51, 1994.

23. Pivetti M : Wicksell's theory of capital. In: The New Palgrave: Capital Theory. eds by J Eatwell, M Milgate and P Newman New York, NY: WW Norton, pp 262-69, 1989.

24. Shackle GLS : Epistemics and Economics. Cambridge, Eng: Cambridge at the University Press, 1972.

25. Tjian R : Molecular machines that control genes. Scientific American, pp 54-61, February, 1995.

26. Turnovsky S : Introduction to endogenous growth models. In: Methods of Macroeconomic Dynomics. Cambridge, MA: The MIT Press, pp 391-424, 1995.

27. Wicksell K : A mathematical analysis of Dr Akerman's problem. In: Lectures in Political Economy, London, Eng: George Routledge and Sons Ltd, pp 274-99, 1934.

Correspondence:
Masudul A. Choudhury
School of Business,
The University College of Cape Breton
Sydney, Nova Scotia,
B1P 6L2 CANADA.