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Gary Langford
Portland State University, gary.langford@pdx.edu

Teresa Langford
Portland Community College

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The Changing Moral Mirror of Society
From Human to Artifical Intelligent Systems

Gary Langford[1], Teresa Langford[2]
[1] Engineering & Technology Management, Portland State University, Portland, Oregon, USA
[2] Business and Accounting Department, Portland Community College, Portland, Oregon, USA

Abstract—**Management of technology and its development carry along the responsibility and consequences for interactions between Human and Artificial Intelligent Systems (AIS). In spite of all good intentions, the effects and repercussions of conflicts between Human and the systems built with intent to assist Human may be proceeding along the path that will recognize a dismal mistake in judgment. Dreadful and intolerable impositions on Human behavior may arise regardless of how AIS is designed. That is not to say progress should cease, but rather to make the case that intensely determined efforts need to delve into the uses and implications of AIS. Heretofore, only the manifestations of goodwill are energizing research and early uses. This paper proposes and outlines the power of applying Systems Model-Based Thinking (SMBT) to begin outlining the realms of behavior that society could be aware. Open discussion to facilitate general awareness is deemed essential to a fuller participation in a useful and enlightened future with AIS.**

I. Introduction

Before we became linked to screens, the only systems that people interacted with were other people. In rapid order, Artificial Intelligence (AI), (i.e., algorithmically based, extensional logic structured, fast search enabled), began revolutionizing a new sociality within a rather labored environment 40 years ago. Commercial development has focused AI to supplement Human behavior. But as yet, AI is not at the level of Human intelligence. The age of mechanical advantage is giving way and supplanted by mutations of technology that will shape an enduring landscape – one that will be less controllable than simple mechanical devices. The history to the future transition will bring about a tempting means to run away from Human self. At risk is our self-awareness, self-management, relationship management, and social awareness – the four dimensions of Human "self" which leads to social intelligence [1]–[2].

As social intelligence is incorporated into AI and Artificial Intelligent Systems (AIS) and Human behavior is realized, the four dimensions of Human self will define the past, present, and future logics through algorithms that mine networks of data and correlate with our individual senses into non-binary state instructions, coaching, and decisions. This integration of the dimensions of Human self into an adaptive, pseudo-algorithmic computing environment will bring about changes to how Human will interact with AIS. The time-enduring boundary between environment and community will be revised, then redetermined by an increasing number of interactions between AIS and Human. The perennial, ill-defined existential gap between all that cannot be controlled by us and the Human innovation what wills it so, may push technology management beyond its present limits. Those limits have yet to be defined. Why is the change so dramatic? If the intention is to design and use AIS to "be" with us, to "help" us, and to "comfort" us, technology managers may rue the moment that AIS "is" us. What role will AIS engage with Human? What is the meaning that we want to ascribe to us through interactions with AIS? And, most importantly, are we to be AIS, is AIS to be us, or is AIS to watch over us as guardians of a more efficient set of Human selves? The consequence of AIS "as" who we are (i.e., our self) may mean a change in identity for each individual – the individual's self that remains and the surrendered Human self that is given up. The surrendered Human self would be comprised of some combination of Human self-awareness, Human self-management, Human relationship management, and Human social awareness. The transition to this new world of surrendered Human self is the topic of this paper. The scope is to apply SMBT to the engineering of systems – the AIS. With a mind toward applying the notions of SMBT, the psychological questions are used only to frame the context, but not to be developed here. An interesting application of the results of this paper is higher education and the role of AIS.

II. General Applicability of Systems Model-Based Thinking

This research is founded in the approach we refer to as a Systems Model-Based Thinking (SMBT). SMBT is wholly new. SMBT expands and enlightens thinking from the nexus of two ontological frames – one based on taxonomy of physical objects, the other based on taxonomy of processes. Stanislaw Leśniewski [3]–[4], developed these two ontological perspectives to capture all universal existence without loss of generality [5]–[8]. Existence implies all physical and intellectual objects and all processes, i.e., in the manner of Parmenides – it exists, it does not exist, it cannot exist. The notion of systems is incorporated into the two ontologies by a set of criteria that rely on the relation of parthood [3]–[4]. In that sense, the relation of parthood denotes reflexive (weak condition, i.e., knows about itself) and nonreflexive (strong condition), antisymmetric, and transitive relations, i.e., a partial ordering [9]–[12].

A. Systems Thinking and Approach

The vast majority of systems thinker pose their systems thinking as constructs rather than as a natural part of the fabric of space. In stark contrast to that typical line of reasoning about systems, we posit that system are *not* merely conceptual constructs, but instead realities of aggregations of objects and

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processes that satisfy four conditions. These four conditions that satisfy the criteria of systemness are metastability, internal agility, external adaptability, and irreversible/non-reciprocal emergence [5]–[8], [13]–[14]. The implications impose a particular order that wholly exists nowhere else; a structure that varies greatly, however with a stability of action and reaction that postures its dynamics and boundaries; and a constancy of meaning that represents force and energy (in the same sense as described in terms of physics). Systems are found throughout the universe – from elementary particles, atoms, molecules, plants, animals, Human, computers, Earth, solar systems, stars, and galaxies. The four conditions of systemsness are found in every system, regardless of size. Systems thinking is the reasoning, organizing, assessing, analyzing, evaluating, judging, mechanizing, modeling and representing objects and their interactions and behaviors, such that the criteria for systemsness is considered, investigated, tested, verified, and explained.

Consequently, a systems approach means radically different things depending on the determinants and principles on which the approach is based. SMBT is constructed through rigorous formal methods, embodied in the mereology of objects and processes, and expressed in a framework of the object ontology and process ontology.

B. SMBT Utility

SMBT can be used to identify the essential requirements for building a sustainable business model (for example) through a mix of technology innovations for products and services [15]. Through the clarifications and characteristics of applying SMBT, the four isomorphic conditions for systems are found engrained in the fabric of the business operations, projects, and governments. The tools and techniques applied within the activities and processes of the SMBT interpretive, integrative framework illuminate the shadowy complexities of AIS. The meaning of Human self derives from social context.

SMBT is used to formulate a set of evaluation criteria that directly addresses inherent complexity of the relations that are to be measured along with the degree of transparency into the causal actions that underpin the results. AIS requires extensive analysis and evaluation to separate interwoven and possibly competing instructions based on interactions with Human.

The pre-eminent transaction is the key transaction that defines the greatest utility of the system being considered. SMBT lends itself to solving a defined problem, answering a relevant question or resolving a conflict – types of research. In each of these exemplars, the key purpose of the system(s) transaction(s) is central to every action of the system, i.e., holism. In addition, there are two sets of procedures for these three research engagements – one to work toward an object or goal, i.e., solving a pertinent problem; the other to explore a vexing concept. The sequence of actions taken, i.e., the method employed, and the causal factors and relations depend on the choice of procedures – explore or aim.

III. APPLYING SMBT

The fundamental assumption of SMBT [5]–[6] is that a system is confirmed as having the highest utility both central to the discussion and at the focus of interest. Therefore, at least one of the aggregations of objects shall be a system. Thus, for modeling the primary interactions between a system and a pre-eminent transaction, the criteria for simultaneously satisfying the four conditions of systemness shall be met for all use of SMBT.

All systems have four mutual properties and various relations (i.e., conditions for systemsness) to differentiate between agglomerations that are not-a-systems (Notasystems)). Notasystems may have one, two, or three conditions satisfied, but not a fourth. Our conception of a systems model establishes a way of viewing all aggregates of interacting objects as systems if and only if the criteria of the four conditions for systemness are satisfied simultaneously. Therefore, systemness implies holism – that a change in any object or grouping of objects directly or indirectly affects the whole of all objects or grouping of objects [18]. Note – the term systems is used to mean a single system as well as a system of systems, and systems of systems as defined in reference [5]. There are corresponding elements in all systems, whether by objects due to grouping, specialization or by results of processes. In that sense of congruence, any system could be the reference for all other systems. A formalism can be constructed to measure the degree of like-kindedness within a particular kind of system. Both homomorphic and isomorphic structures may suffice for comparing and measuring systems. Mapping homomorphically preserves structure, while mapping to identify isomorphic determinants determines degree of similarity of process [17]. Depending on the degree of homomorphism or isomorphism between like-kind systems, the taxonomy for each like-kind system can be developed and applied to method, defining stakeholder perspectives, and interpreting results derived from SMBT.

In context of AIS, the meaning of Human self is discernable from SMBT within the social aspects of a business model. Self is deterministic.

A. Stakeholder Viewpoints

The viewpoints of stakeholders involving transaction(s) between a Human and AIS (where the sum of all interactions comprise the lifecycle of a transaction) are described by SMBT as an individual (object as a system) interacting with AIS (object as a system), where both objects are systems. This connection between a Human and AIS is the pre-eminent transaction, by which all actions of each of these two systems have all activities at risk due to each's holism. Depending on the capability and opportunity that avails each of these systems, data from each can be transferred. Data can be put forward, observed, and conjectured. With extensive, fast network access to peta-bytes of data, AIS could confirm and infer additional information about Human. Connectivity, computing power, and network availability to data repositories favor AIS over that of a non-computer-aided Human.

Stakeholder viewpoints will differ. SMBT in identifying the effects of interaction.

IV. Products and Services

In times-past, actions to use technology were self-limiting and self-regulating. People held the power to use the product or service to do what they wanted or needed. The differences between products and services are incorporated into product development and service formulation, enhancement, and upgrades. Products that are systems generally exhibit improvements to their associated services. AIS is both a product and a service. Therefore, products and services frame contexts for Human self.

Products are classified as those discovered, invented, and innovated as a means to entice buyers and users to own. Services are determined to support the user with what was needed so the user could continue to use the products related to their purchased service. Ultimately, those uses are limited only by the user who had full control over the entirety of the product, including maintenance and repair, parts replacement, and storage. Outside the purview of other users and non-users, the user worked within the bounds of self-imposed rules, principles, and skill-derived practices. In that way, the use of technology is regulated by the user. Personal control was underscored by regulating the decision to buy or use, having the willingness to pay or accept consequences of use, and then by taking part in the transaction to purchase or accept responsibility for said products and services.

However, that willingness to pay and use does not imply tacit agreement on the part of the buyer to participate in the channels or means of distribution associated with those products and services. The buy-sell transaction may or may not have been influenced by the channel through which the product or service was delivered. And beyond the terms of warranty or return, there was no implied, persistent linkage between the user and the product or service. Neither product nor service had the properties, traits, or qualities of a system. And while services might be provided by the vendor or third-party (i.e., systems), whose influences on the purchased product or service were restricted to interactions with the user or customer, the expected intent of purchased service was to aid the user or customer and not to moderate directly the use of that purchased service. In other words, since there was no way to operate or use a product by someone other than the user who had direct contact with that product, the purpose of servicing that product was focused on helping the user. The user was empowered as a surrogate for the vendor or servicing company.

The division of control of the product between the user and the seller is strictly enforced by any non-systems-like behaviors of the product; and the servicing of the product strictly relegates the onus of responsibility of delivering the service to the service provider and the use of the service to the owner and user of the service. That strict delineation of roles and responsibilities is changing with the advent of leased software, network and cloud services, after-sale interaction with products by the seller, and artificial intelligence.

The world of AIS will not only change the division of control (of Human self), but also the degree to which the user may be able to redefine and change the boundary of control. The user may need to take back Human self which may seem to have been lost to the AIS. With modern day vehicles, most users will find difficulty in tuning up the engine. Diagnostic codes in the on-vehicle computers are used to diagnose problems or issues to investigate. Often, these codes are used as final checks for automated tune-ups of engines and engine peripherals. Today's vehicles (even with their advanced sophistication in AI technology) are not systems of systems and therefore not AIS counterpoints. When AIS becomes the vehicle, the support for the vehicle, the scheduler for maintenance on the vehicle, and the keeper of confidential information and software that pertains to intellectual property of various AIS key stakeholders within the AIS business model, the boundary between AIS and ownership will be blurred. This separation of what belongs to the AIS and appears to belong to the user is rather indistinct and not apparent. Who owns the AIS vehicle? The business model may support the distinction between ownership and lease. Much as we find software for our computers purchased on a monthly or annual lease basis, we are finding more software residing in the aggregation of vendor's "cloud" services and not available on compact discs for only our computer. The service part of AIS enables the product, changes the boundary of control, converts the monetization of use, and takes away user autonomy.

Distinctive properties, traits, and attributes [5] of systems and systems of systems are devised to adopt synthesized sensibilities by suffusing AIS into all types of interactions with people, including instructional, social, financial, educational. We distinguish between artificial intelligence (AI) which can be found in systems or systems of systems, and AIS which is meant to mimic (or exceed) the Human capacity for various types of thinking and intelligence. AIS is set to imitate Human, distinct from AI that intimates knowledge. All interactions between AIS and Human is in the context of a system of systems. The essence of Human self within that context is impacted by every interaction with every constituent system within the system of systems. To unravel that multi-dimensional context is to labor in nearly every discipline.

V. SMBT Interpretive Integrative Ontology Framework

SMBT helps discern and capture the myriad of stakeholder views that comprise all interactions between Human and AIS. Each stakeholder has a need that is to be satisfied, a problem that is to be solved, and perhaps requirements that shall be provided.

A. Functions

AIS is replete with functions, functional performances, and quality that are expected and required by stakeholders to the central interaction between AIS and Human. Functions result from the useful emergence due to objects that interact. Two objects interact through the exchange of Energy, Matter, Material Wealth, and Information (EMMI), from which emergence is the byproduct of that interaction. A user interacts with an object (i.e., two objects interacting) resulting in emergence, some of which is wasted energy, unwanted action, and an emergent that is a function used to perform a task. That

task requires certain performance and a minimum level of quality. The useful emergent is a function. AIS will be designed and implanted to have various functions. SMBT captures the physical objects and their useful interactions (as functions), the resultant behaviors (of objects), and waste products (in terms of losses of EMMI). Additionally, SMBT tools will identify and quantify the unused or unusable emergence to determine the loss of EMMI it took to provide the user with the desired function. Functions can be thought of as the capacity of the action performed, whereas processes build that capacity.

This approach ensures all interactions are represented as shown in Figure 1 as the canonical interpretive integrative framework. The form, structure, and mereology are the bases of the ontologies of objects and processes. The design space for both AIS and the processes that drive the interaction between AIS and Human are shown in form as how the physical objects are presented, in structure are configured, in mereology as they are categorized as parts and wholes.

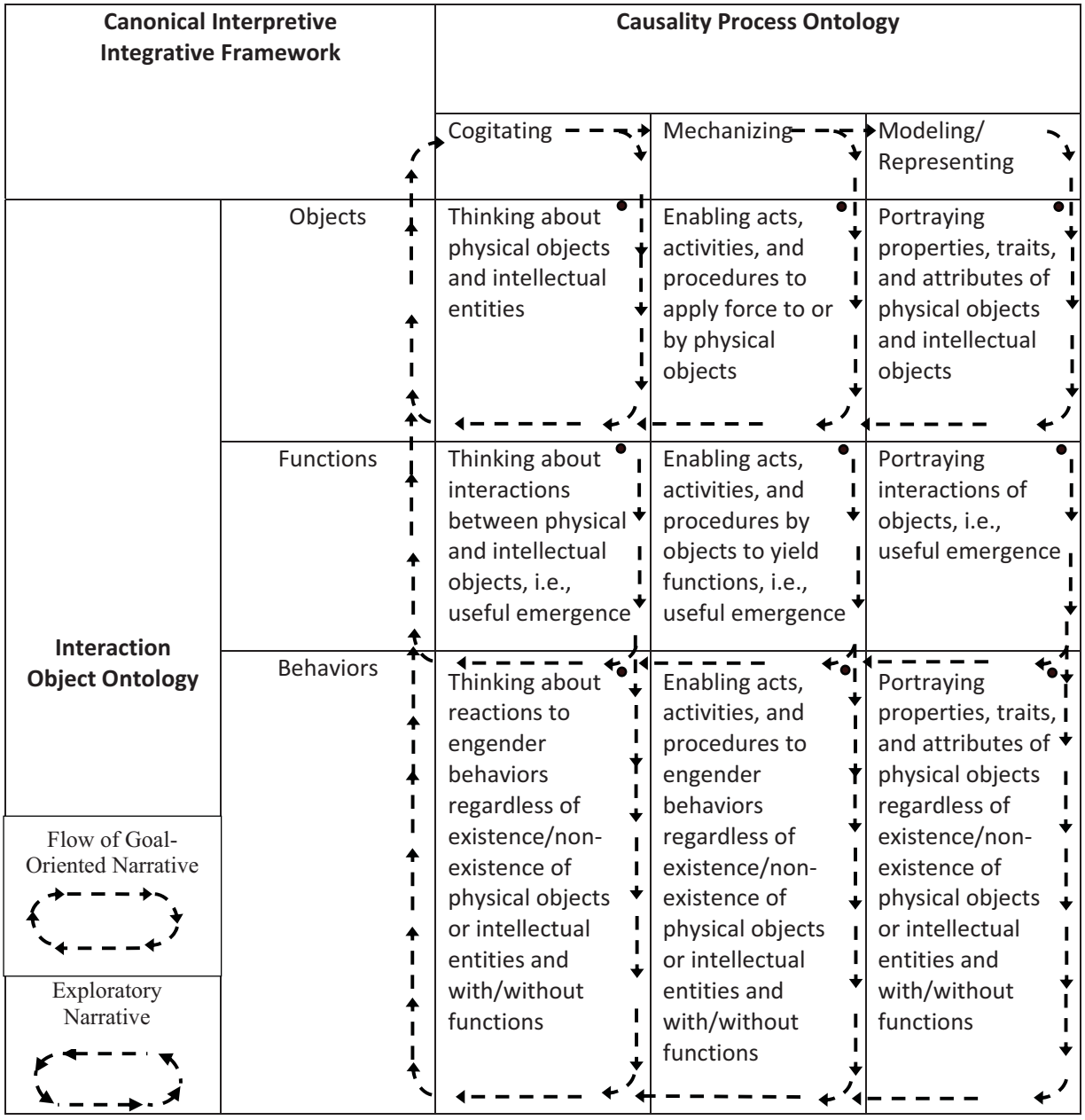

Fig. 1. Canonical Interpretive Integrative Framework

Within the canonical interpretive integrative framework, the syntax for modeling systemic actions results from the allowable interactions stipulated according to the direction of analysis through the row-column nine-nexus squares (see Figure 1, column left and row top). These perspectives define the object, functional, and behavioral boundaries, the cognition, mechanisms of apply force to objects, and modeling the dimensions and measures needed and required to determine and forecast interactions between Human and AIS.

The framing of two intersecting ontological domains grew out of the desire to represent all the actions of the lifecycle of a project, concatenated into the structure of a business [5]–[8], [9] and based on Stanislaw Leśniewski's "Foundations of the General Theory of Sets" [3]–[4]. The basis for SMBT is this expository framework of object-related and process-related concepts to incorporate all interactions of EMMI. The most general expression of a mereotopology framework codifies a formal, comprehensive ontology that represents all knowledge [18]. The canonical interpretive integrative framework portrays the three dimensions of process taxonomy along the abscissa axis along with the three dimensions of object taxonomy along the ordinate axis. All that are objects are objects of physical and intellectual merit; all that are processes are activities and not objects; and all that are not objects or not processes cannot exist. Mapping the three quantifiable dimensions of objects to each of the three qualifiable dimensions of processes depicts the allowable interactions – all of which are causal [14] to emergent outcomes [6], [13].

VI. Introducing Ontology Frames of Objects and Processes

The physical frame in SMBT denotes physical objects (and agency through intellectual entities) as objects and their physical emergents of interaction and resultant behaviors of objects. AIS will be made up of physical parts and intellectual property that combine to be the objects referred to the object ontology. As those objects interact (and present useful emergence that we term, functions) processes will be carried out by which to interact with Human. That interaction will be facilitated by objects (that the designers plan to not interfere with the timely and clear communications with Human. Human will also interact through objects with the expectation there will be accommodations for Human error, timeliness to respond with information Human needs, and with sufficiency of accuracy and precision so that Human can trust and rely on AIS. The physical objects set the structures for integration, functionality and performance, interoperability and losses of EMMI. The efficacy of the AIS constituent systems' business models are domineered by physical and intellectual objects. Stakeholders can apply SMBT to suggest best fitting technologies and means to innovate with those technologies as well as to evaluate desired technologies to determine feasibility and appropriateness within the set of existing or new technologies.

The process frame captures acts and activities of cogitating, mechanizing processes, and modeling or representing the activities of thinking, mechanizing, interacting, and behaving. This ontology frame provides the force to make things happen by following strict rules which allow intersections between the two frames. Clockwise logic is used to reach a goal and counterclockwise logic explores a concept. The same sets of interactions within the framework of these two frames are reducible to the same canonical form. The order of interpreting the result from the nexus of object and process frames is irrelevant to the sequence of actions taken clockwise or counterclockwise, i.e., stakeholder independent, albeit the questions are formed and answered differently, depending on the intention (i.e., clockwise or counterclockwise direction) of the logic.

A. Goal-Oriented Logic Used Within the Interpretive Integrative Framework

If the goal is to determine the requirements for an AIS that maintains the four aspects of Human self, then we cogitate about the objects that are necessary, the functions that need to be derived or enabled by interactions between those physical objects, and the behaviors that will result from those physical objects, functions, and behaviors. We determine the mechanisms that must be put in place to acquire, develop, place, support, and maintain those physical objects; determine the mechanisms that must be enabled to force the physical objects (with energy, mass, material wealth, and information) to accomplish what is intended; and determine the modeling that must be carried out to finalize design and perfect operations. Requirements can then be determined and stated as needs of stakeholder that must be quantified and tested according to relevant and appropriate specifications or standards. For AIS, those requirements likely incorporate computer hardware and software that must be constructed.

B. Exploratory Logic Used Within the Interpretive Integrative Framework

If the interest is to explore (e.g., research) the dependencies of Human self on various aspects of AIS and interactions with AIS, begin with the physical objects as they are instantiated in a design or corporeal setting. Within the Object ontological frame, describe these objects, indicating their as-is characteristics, actions, properties, traits, and attributes. Then, describe the functions (i.e., the useful emergence) that are active and when. Describe the mechanisms that are associated with those functions. And, finally describe the behaviors observed. Within the Process ontological frame, describe the thinking, then the rationale for mechanizing the activities, and the modeling of the thinking and the mechanizing processes. The results of the processes within the ontological frames establishes the baseline knowledge from which to pose research questions, explore correlative (and causal) activities, and model the observed phenomena. In a naïve sense, the result of exploration or research is to interpret, analyze, discuss, or theorize with data to inform approach or method, to identify gaps in cognitive mappings of information, to contribute to the body of knowledge, and to create value for product or service innovation. A focus on evidence-based outcomes as well as formative ideas from which to base plans for additional work is typical of exploratory logic within the interpretive framework.

C. Canonical Interpretive Integrative Framework Mereotopology

The object frame is an abstraction of a subset of classes within the object ontology and the process frame abstracts a subset of classes within the process ontology [6]. The object ontology includes the extant physical objects, the interactions between physical objects, and the resultant behaviors of interacting or non-interacting objects and the resultant behaviors from expected objects that exist or do not exist. The process ontology includes cogitating, mechanizing, and modeling. These subsets of classes within each ontology form the taxonomy related to notasystems (not-a-system), systems, and systems of systems [6]. The ontologies and their individual frame taxonomies are represented in a canonical interpretive integrative framework [7]. As determined by the totality of intersections in the interpretive integrative framework, shown in Figure 1, these interactions between the object frame and the process frame post the only allowable interactions between the two sets of taxonomy. This topology provides a semantic model to decode, interpret, and predict emergence, i.e., consequences of interactions between the nexus of objects and processes within the 3x3 matrix as depicted in Figure 1, updated and revised from [5]–[7].

VII. SMBT Applied to AIS

Systems are observed to have dynamic actions that are orderly and sustained within a common structure that satisfies the four conditions of systemsness (Section II). A collection of interacting parts connected to form an integrated, interoperable aggregation is referred to a system if the aggregation conforms to the systemness criteria of four conditions: Metastability, Internal agility, External adaptability, and irreversible/Nonreciprocal emergence (mien). The word, *mien*, is dictionary-defined as the manner or indication of inherent character.

A. Character of Systems

The character of a system is to accept or enable a periodic, recursive process of flows of EMMI that provides for a metastable (i.e., long-term) state of equilibrium to enable its operations; to respond dynamically to its endogenous environment by enacting internal processes through agile internal exchanges of EMMI; to adapt to its exogenous environment by rejecting, or accepting and using EMMI; and to enact irreversible or non-reciprocal actions, i.e., emergents . Note, the term *emergent* is attributed to George Henry Lewes [19] who first noted there were unintended effects caused by integration of objects. Emergence refers to all changes (seen, unseen, unforeseen, expected and unexpected) due to interactions of EMMI between objects [13]. Emergence is a natural consequence of all interactions, integrations and interoperabilities. Emergence always occurs when two physical objects interact.

Intelligent Systems (specifically, Human for this paper) are able to perceive, act, and learn autonomously to create individualized essence of Human self. The sense of Human self is the individual's essences which distinguish one person from another person.

In particular, note that while variously defined, technology can be thought of as any process or physical object that extends an existing capability to support, sustain, enhance, or improve the functioning of a product or service [20]. Whether the technology is embedded in a system or not, this view of technology exposes the perhaps-not-so-subtle differences between stakeholder views of the same technology. Stakeholders who interact with AIS may have markedly different experiences of utility and capability than those who derive value from that interaction.

SMBT is a highly regimented way to account for all aspects of AIS and its interaction with Human self. The various perspectives of interaction, the juxtapositions of physical objects, and the provenance of actions that are expressed during interaction lend themselves to interpretation based on the different perspectives of AIS and Human. For example, the game of chess is view from multiple perspectives. Each player experiences the game from their side, spectators sometimes view the play-action from neither side (e.g., down looking). Same game pieces, different patterns, with often different interpretations. SMBT is without preference for a particular view – the choices are left to the participants in SMBT. SMBT supports all views, including from AIS (to include at the time of interaction with Human; from each stakeholder perspective during development, testing, and validation; and when preparing, structuring, prioritizing, implementing, and responding to data queries); from Human (for example – direct interaction or vicarious interaction with AIS). Consequently, there are perceived and real differences of the benefits of AIS.

B. Benefits of AIS

These differences in perspectives of the benefits of AIS increase as the AIS begins to accumulate and employ more extensive information about the lives of an increasing number of individuals. If the AIS has no information about the individual involved in its interaction (i.e., a complete stranger), the AIS will attempt to relate any information that it gleans from the interaction to formulate a more appropriate, tailored response. As the AIS learning continues (i.e., as the change from what was known to what is now suspected or corroborated), AIS knowledge about that individual and demographically-like-kind individuals increases. Given network accesses to a plethora of databases, learning and knowledge change rapidly. It could be surmised that the more advanced is the AIS (culturally-sensitive) interrogation of the target individual, the higher the willingness for the individual to participate in the interactions. Human willingness could be moderated by the incentives or disincentives communicated or implied by the interactions. The AIS must be sensitive and refined in those interactions with Human to be perceived as helping Human. In essence, we might suggest that AIS is becoming more aware of Human self, i.e., increasing its social awareness.

C. Exploratory and Goal-Oriented Narratives for AIS

Figure 1 illustrates the two applications of SMBT with the exploratory narrative (for example, expressing the desire to investigate what technologies are best) and the process flow of

the goal-oriented narrative (investigating technologies that are of interest to various stakeholders). These technologies may have been envisioned, developed, or licensed with the expectation of being used within the AIS. The make/buy decision for stakeholders, who want to participate in various types of business models, is incorporated into the deliberations about the appropriateness and utility of the two paths to be involved with AIS technologies.

SMBT distinguishes between functions and mechanisms as the difference between measurable performance (functions) or processes. Functions are the useful emergence of interactions, i.e., rubbing hands together vigorously creates a quantifiable amount of heat, i.e., energy. For example, the process of rubbing two flat pieces of metal together is a mechanism of force, e.g., the process of rubbing physical objects. As energy and force are distinguishable and differentiable, so are function and process, respectively. Function is related to the result of objects interacting, while process is related to activities that enable mechanism that enact force on objects [5]. Energy does not move objects, forces (i.e., processes) do move objects. A change in kinetic energy of an object is equal to the work done on that object by a net force.

From the view of SMBT, a change in functional performance requires a process to intervene in the actions of an object. Without intervention, the functional performance will continue as long as the precipitant interactions (between objects) continues. That intervention could be a button press, or a change in the interaction that slows the action down, e.g., friction (a kinetic force).

A typical narrative for applying the language of SMBT is exampled by considering how friction (i.e., the frictional resistance between rubbing surfaces without oil or other material to overcome friction) depends on the properties of surface materials (relative hardness and melting point) of the rubbing objects. Specifically, the various mechanisms of shearing of the surface junctions formed by adhesion and welding at the points of contact result in a change in kinetic energy due to dragging or gouging the surfaces' unevenness. Interactions continue at the peaks of rough irregularities [21] – the smoother the surface, the broader the peaks and the greater the friction. The result of the process of rubbing metal surfaces is the emergence of abraded surfaces, heated metals, and radiated heat. The amount of heat is measurable, the amount of abrasion is measurable – all are emergents and if any is usable, then what is usable are functions produced by the process of rubbing the two metal surfaces. For example, heating of the metal surfaces may result in a bend in the material, which may be planned to be the desired result. The function of 'to bend' is measurable by deviation from a flat plane standard. The activity of rubbing metal surfaces is verifiable, the activity of measuring heat is verifiable, and the change (if any) in the surface of the metals is verifiable. Verification is the comparing (process) of objects or processes (the set of all activities and acts, i.e., an object) to definitions (object), requirements (object), standards (object), or other processes (object) by means (process) independent of those involved with the objects or processes. The particulars that are exposed by using SMBT at the nexus of objects and processes (indicated by a solid small dot in the upper-left corner at the intersections between the object and process frames in Figure 1) span all aspects of the actions of two metal plates rubbing.

For AIS, the notion of friction is omnipresent for all interactions of objects. We chronicle both the useful outcomes through the expected functional performances as well as the emergence that often results (for example, results in radiated energy, often in the form of heat). Early work for demonstrating AI was carried out on energy inefficient computers. Even with the advent of increased speed and less energy consumption per computing node, large back-office computing infrastructure will continue to generate significant heat. These losses due to frictionally generated heat adds to the cost of providing the AIS-Human experience. Early work is suggested to determine the net loss due to emergences that do not provide functionalities beneficial to the AIS-Human experience. The general loss function [22] is an apropos tool to help determine the net benefit to the AIS system of systems and the Human systems of systems.

Additionally, new areas of investigation are suggested by the SMBT processes. In the case of friction, the actions of quantum mechanical effects of surface work functions and new bonding mechanisms for dissimilar metals are suggested to aid in miniaturizing electronics and sensors. Another advancement in technology that may inspire innovations to better AIS is to incorporate intensional logic into its existing extensional logic. Extensional logic spans categories of topics and empirical ideas used to search, look-up, and retrieve information from databases. In stark contrast, intensional logic concerns the wholeness of conditional statements to include ideas and concepts. Incorporating intensional logic greatly improves the ability of AIS to interact more naturally with Human. To add intensional logic is to delve deeper into Human self. Consequent from the mereology of objects and processes as enacted through the object and process ontology frames, AIS requires both extensional and intensional logic to interact using Human-like essences with Human [23].

D. Priorities and Control Architecture

Indeed, great attention to the details of interaction are warranted to carefully structure the operations of AIS and the interactions of AIS with Human. Giving the proclivities of social media and their wide-ranging influences, it may be best to baseline the AIS design on only the specifics of what Human wants based on what Human provides at time of interaction of AIS and same Human, only that provided by Human will be data applicable for that Human. The model suggested is that of the personal medical record for an individual Human. Thereafter, for every interaction with that same Human, the social record, and therefore the Human self is used by Human and perhaps managed by AIS. The impetus is to limit the intrusion of AIS into Human self. This posture focuses interactions on the one-to-one, without extensibility and network externalities that are driving forces in Human-to-Human interactions.

If AIS is envisioned, promoted, and held to be many-to-one, one-to-many, the Human self will be changed. Those "many-to" and "to-many" interactions are readily considered through the existing work in psychology, sociology, finance

and accounting, and business. The wide range of disciplines on AIS design teams *and* AIS architecture teams who structure priorities that arrange physical objects and determine the order of execution of processes should consider the social intelligence of the interactions with Human, as well as the hierarchical inferences and rule sets that mediate allocate resources. Integrated multi-disciplinary teams will need to deal with the capacities of information, and the movement of that information to support AIS-Human interactions. The tension in the design and architecture will be punctuated with distributed priorities competing for attention from AIS and Human at the AIS-Human interface. The competition for AIS is how to mediate and manage the flow of information (e.g., from which source or what economic model). The competition for Human is partly determined by the amount of time that must be committed to the AIS interaction, the location of that interaction, the ability to record and then retrieve the results of that interaction, and the access to the AIS for follow-up information. The adjudication of possibly contentious fulfillment of multiple business models (from multiple stakeholders), should have the mediated result of minimizing the loss of EMMI for all of the AIS constituent businesses [22]. Without satisfying the prime design objective of minimum loss, other non-systemic solutions will jeopardize lowest cost, highest benefit operations. Therefore, sustainment will be non-Pareto-optimal.

Further, the priority and control issues within the AIS architecture can lead to delayed response to the Human. Operations of the AIS will be driven by the size and willingness of the Human wallet to buy preferential control over data or to enforce Pareto-optimality, as overseen by the results of a loss function [22]. SMBT supports the nature of the systems of systems through minimum loss as the most effective provider of services and products [5]. Through the use of construct of minimum loss, SMBT can be used to examine trade spaces, tradeoffs, and event and consequence analyses.

E. Amazing Process Similarities of Systems

We can harness SMBT to extend the physical concept of improved functionality, i.e., the useful consequence of interactions between physical objects, to the social concept of function, i.e., role or use. We establish a construct for comparing likenesses between social systems and non-artifactual systems. These non-artifactual systems are also non-Human social, meaning that an operating computer has only the personality that is prescribed to it by sentient beings. Here we distinguish between Human social systems and natural systems, e.g., trees as non-artifactual systems that are also non-Human social and living systems; and molecules as non-artifactual systems that are also non-Human social and not living systems. Systems take many forms, but regardless, all systems satisfy the four conditions of the systemness criteria (Section II). SMBT reinforces the significance of these criteria in all aspects of systems and systems of systems, (such as AIS) because to do otherwise is to operate with inefficiencies and without mechanisms to correct those inefficacies. The business model is an example of systemsness, i.e., system or system of systems structure and thinking within the interpretive integrative framework (Figure 1).

F. Sociological Functions

Consistent with the SMBT expression and use of function, we incorporate Radcliffe-Brown's social concept of function [24] as a utility of interaction in Human societies. Note, the use of the word function in this paper is that of a rational-function, rather than "functional" in the sense of having reference "...to the conditions and positions of a social system's integration or equilibrium..." [25]. Through SMBT, we settle that if there is no interaction between objects, there is no emergence and no function – if no function, then no performance. However, without object(s) or function(s), there can be changes in behavior (see Figure 1). Moreover, there can be various and likely differing viewpoints. And, what is useful for one person may be distractive or disruptive to another person.

At a meta-level, the continuity of society has structure-like behaviors (objects and processes creating relationships) but the relationships are ephemeral and therefore not venerated structure. By short-term continuity of these structure-like behaviors, while the objects of society may change or be replaced, the system (the whole of constituent systems we refer to as society) continues in a dynamic way. The manner is dynamic, yet stable in terms of overall flows of EMMI. Dynamic stability is a direct consequence of the four conditions of systemsness. To sustain social structure, functionality must be preserved and sustained, in spite of objects changing or being substituted or replaced. AIS relies on the functional dispositions of its activities as the means to ensure effectiveness. Observe that the row of functions in Figure 2 provides the measures of performance and the entire set of interactions between the object frame and the process frame illustrate the measures of effectiveness for *all* object-process ontological actions.

Consistent with SMBT, the Radcliffe-Brown expression of "function" by this social-borne interpretation is representative of the partial contribution of an exchange of EMMI between constituent objects (e.g., individual and AIS) within the whole. Additionally, Leśniewskian formal logic provides insight into the rules of action within the interpretive integrative framework that show less loss than is found by ignoring or violating that rule-set. The rule-set is exampled by the amount of loss that occurs with two objects interact. If one of the objects is irreparably harmed, then that harm extends to all of society – to the extent that the demise of the harmed object reduces the EMMI of other objects in the system. The action (or lack of action) of any object within a system degrades the performance of the system. Both Leśniewskian mereology (parts and wholes) and the observations made by general systems theorists and practitioners, support the claim that all parts of a system are in some way affected by all other parts. As a consequence of parts and wholes, the boundaries of the harmed object extend by physical contact, and as a result of consequences of those physical interactions (i.e., functional contact), and then to behavioral contact [6].

Through the approach of SMBT, any change in an object results in a change in functional performance and in behavior.

Systems may not be sensitive to all changes, as there may be thresholds above which the change is discernable and thereby then having an effect on other parts of the system.

Society has unity of functional exchange of EMMI, which means its processes do not create ultimately unresolvable conflicts and EMMI is not conserved (in all systems). That is to say, there must be an input of EMMI from outside a society, an input and distribution among the parts of society that is metastable. And, an irreversible or nonreciprocal action must occur. For AIS to co-exist in a dynamically stable society with Human interaction being a key factor impetus for a dynamic input, both the ultimate intent as well as the transition to achieve that ultimate intent of AIS must be seen to add acceptable value and be held accountable for increasing worth [5]. Value is the increase or decrease in performance per the expenditure of EMMI to achieve that performance. Worth is loss in EMMI experienced to achieve the value. Adding value from some stakeholders' perspectives may not be understood as adding value, but rather decreasing the worth to a different set of stakeholders [5]. Interactions between AIS and Human may well be in opposition as to value and worth.

VIII. SMBT and Relational Models Theory

We incorporated Alan Fiske's, Relational Models Theory into SMBT to categorize the complexities of social life by societal structures [1]–[2]. Here, we use Fiske's four modes of behaviors to reproduce the relations between objects and the interactions seen in every culture. Fiske's modes are communal sharing, market pricing, equality matching, and authority ranking. Communal sharing incorporates familial groups contributing and taking what they need. Market pricing considers the buy-sell scenario to extract a best deal through arms-length transaction(s). Equality matching is reciprocal exchange. Authority ranking displays dominance of one social agent that results in unequal exchange with an implied one-sided obligation. In concert with Fiske's model, each of the four modes of behaviors can be transacted through the exchange of some form of wherewithal – the means, rules, or resources needed or wanted for a particular purpose. These modes of behaviors differentiate stakeholder views as communal sharing, market pricing, equality matching, and authority ranking. The advantage from the AIS perspective is to provide a loss-function driven mediation that poses no existential threat to Human. The difficulties to enact such an allegorizing world may alienate parts of society that want pecuniary gain at the expense of others. The loss function may be deemed essential to exposing the pocketeering of EMMI associated with AIS – Human interaction.

A. Familial Action

At the family level of action, there can be nearly as direct an interaction with AIS as the Human who in fact participated directly in the interaction with AIS. These effects may be delayed or muted due to the level of acceptance of AIS by each family member. Communal sharing expresses activities of familial groups contributing and taking what is needed expressed by wants, needs, and requirements (beneficial exchange of EMMI). For example, if only a few members of a familial group interact with screen systems, the views of that few-member group will diverge from the larger non-screen user group's view of screen interactions (market pricing moves some members to become part of the technology adopter group – gain in EMMI), while the screen-using group still influence (authority ranking for gain in EMMI) the larger group to defer, reject, consider, or concur with the appropriateness of AIS in its described context. In the same manner that teenagers help to morph language by incorporating new vocabulary into their language, so it is with screen-users' sway over non-screen users. The growth rate of screen users to total number of screen-users plus non-screen users will follow an adoption-extinction curve (equality matching for in-kind consideration and respect – EMMI). SMBT exposes the kinds of behaviors due to object-to-object interactions through the language, precepts, and theory of behavioral psychology. Here, familial actions epitomize instantiations of authority ranking, communal sharing, equality matching, and market pricing. Human self is reinforced, attacked, changed, or modified in communal sharing.

1) Adoption-Extinction Curve

An insightful means for constructing an adoption-extinction curve is to consider the losses due to the rates of adoption and extinction by members of the group who use a technology. The derivation of the general loss function [5] and its application [22] illustrate how adoption curves can be formulated based on the tension between adoption and extinction rates. This loss function method has a distinct advantage over the four scenario methods: demonstration, driving force, system change, and slice of time [26]. Scenarios are described by Kahn, Brown, and Martel as "hypothetical sequences of events constructer for the purpose of focusing attention on causal processes and decision points" [27]. Further, since the objective of a scenario is to build a schema from which to extrapolate, compare, contrast, and analyze alternative adoption rates, the propitious manner may be to identify and quantify the causal issues, "that are often overlooked in general or abstract analyses and discussions" [28]. Since, losses to users correlate directly with usage data of the adopted technology, users' experiences (collected by means of surveys) signals extinction, and identifiable network externalities create impetus and value (in spite of losses) indicates adoption, a sufficiency of information can be assembled, analyzed, and tracked to posit adoption-extinction rates due to AIS interactions, feature sets, and perceived value and worth.

2) Accumulate EMMI – Sustain Competitive Advantage

A natural result of exchanging technology within one of Fiske's four conventions is an eventually strong deference for superior priority through the mechanism of Authority Ranking. Superior has priority over the inferior on the grounds that superiority is higher in preferential ranking, higher status, or higher functional performance or quality [5]. Superior priority can result from the accumulation of power, wealth, influence, or social dependencies (other aggregations of EMMI). Accumulating EMMI and sustaining a competitive advantage in Equality Matching or Authority Ranking is encouraged and fostered by recognizing the "...systemic

combination and integration of knowledge..." [24]. The mechanisms of applying the concept of economies of scale, taking risks for a lucrative return, or investing for EMMI in excess of investment are commonly cited as means for accumulation of or managing access to EMMI [5, 29].

B. Market Pricing

Market pricing encapsulates the buy-sell encounter as a contest, necessity, aggravation, or opportunity to access necessities, cravings, and gifts. Roles for AIS in market pricing (the seller's perspective) include knowledge-based pricing which tracks the buyer's preferences, value of online search results, and benefits from social media posts to more effectively qualify the buyer. Given that in the typical buy-sell activity, the seller is shown to generally have the overall advantage, the role of who is the buyer and who is the sell may be determined at the time of interaction. The manner, means, habits, and perceptions of who is selling information and who is buying information may become a key trait of the AIS. The fluidity of a transaction may determine the value and worth of AIS. The advantage of a seller is recognized through the buyer's purchasing behaviors [30] – the art of the best offer; using a better understanding of the psychology of adopting new products [31] – deciphering buyer's irrational valuation; and knowledge-based marketing at the point of purchase [32] – plying the sense of Human self. AIS knowledge of each individual buyer and seller can potentially reward both the parties to the transaction(s). If a way can be put into the AIS to demonstrate convincingly both value and minimum loss to both parties [5], [22], AIS may be better designed with a congenial, beneficial mannerism.

C. Equality Matching

Equality Matching is the reciprocal exchange of EMMI, typical of a long-term relationship – affinity rewards for participation over an extended time. AIS manages the frequency and duration of interaction with each individual buyer and seller. AIS mapping of the interactions of buyers with sellers and associating their various contexts and conditions of purchase may enlighten the frequency of purchase with buyer's habits and propensities, and provide sellers with opportunities to make different product or service offerings and more frequent sales.

D. Authority Ranking

Authority Ranking captures the dominance of one social agent over that of another social agent that results in unequal exchange coupled with an implied one-sided obligation – a negotiated inequality. Not often is there equality in social agency. One party to a transaction may have inherent dominance either permanent, essential, or characteristic. Permanent dominance is authoritatively derived through governance; essential dominance is akin to parenting; and characteristic dominance originates from context and environment. Social agency refers to thoughts and behaviors taken by individuals and AIS that express their essences of self through the judicious exercise of power. Physical objects have boundaries and intellectual objects, in addition, have justification, motive, impetus, and explanation that reflect their agency relations with corporeal physical objects. A rock, a tree, a thought are all physical objects. The categorization of authority may present AIS with only a few options, whereas Human may have several more. AIS may not be able to "walk away" or simply shut down, depending on situation and physical manifestation of interaction within context and structure. Human may also not be able to conveniently leave the reach of AIS. AIS may not be able to threaten or intimidate, but rather may only be able to deny access to wanted, needed, or required data and information. Humans may damage. AIS may also be limited in the elements of controlling how the transaction transitions from start to finish. What interaction is required for the Human to continue with the AIS until the AIS is satisfied with a threshold of interaction and data? AIS may be limited in each situation – missing the sense of self. Human may be limited in other ways, in part due to Human self.

E. Non-exploitive Motivations

In general, transactions or negotiations based on in-kind bargaining are intended to enhance performance of existing functions carried out by an individual or group [5] or AIS. Working efficiently to save energy, using materials more effectively, saving money when acquiring services, and making more informed decisions are examples of using technology to better implement one's intentions. Ideas inspire, technology enables, and innovation creates value. Yet, it is the determination of worth or feeling that the interaction with AIR is worth the presumed benefits that weighs heavily on the decision to interact knowingly with AIS.

IX. Conclusion

AIS presents a complexity that effectively must mask the innerworkings of Human cognition, mechanizing activities, and the primitives of how knowledge and information is learned, stored, retrieved, concatenated, and communicated. In other words, the economies of the Human self often find the path of least resistance, the benefits of expediency, the joy of fulfilment, the moment of gain, the undercurrent of ethical behavior, and the spirit of freedom.

The dichotomous ontologies parse the universe into things and forces that change things. Since Aristotle (c.350 B.C.E) expressed the simplicity of parts and wholes, it has been on the minds of thinkers. With Leśniewski formalization of parts and wholes by flawless, unpatched mathematical logic (coupled with the premise of objects and processes, i.e., mereology) a logical next step was to develop an approach that advantaged their use. The result was Systems Model-Based Thinking.

Actionizing the interactions of physical objects through the physical concepts of force and energy anchors SMBT in the familiar physical world. Mapping the sociology of functions into the empirical world of object-to-object interaction formulates behaviors from interactions with and without objects and functions. The ontological frame of objects is complete. The ontological frame of processes works through thinking, enabling activities to force things, and

modeling or representing that thinking and mechanizations. The ontological frame is thus complete. The notion of self is embedded in the 3-taxonomy-frame for objects and the 3-taxonomy-frame for processes, Figure1.

The ontological frame of objects intersects the ontological frame of processes to form a framework by which to integrate and interpret each of the parts of both ontological frames. In that way, behaviors, functions, and objects are thought about, acted on, and modeled. Thinking (process) that results in a thought is at once an object. Concomitantly, the rules of action are indicated at the intersections of the two frames. The directions of flow to explore a problem, question, or conflict is counterclockwise from object to thinking, object to mechanizing, and object to modeling. The clockwise flow from thinking to object works toward a previously defined goal. Exploration or goal drives the model for inventing, investigating, developing, fixing, disrupting, enhancing, destroying, or improving systems or systems of systems. The result is a multidimensional probe into complexities that stymie understanding by other approaches, even exceptional approaches. The result is detailed scrutiny or abstracted perspective of insight and action, consequence or strategy, loss or effectiveness. The universe according to SMBT demarks and describes the workings of systems and Notasystems, system of systems and systems of systems. Fundamentally, SMBT illuminates the unseen as it is causal with the seen. SMBT describes what is or could be, what is not, and what cannot be. To that end, SMBT does not answer the question, why.

Expressing AIS through the lens of SMBT enables the prowess of the interpretive integrative framework to ferret and describe relationships virtually unseen by other approaches – systems oriented or not systems enabled.

REFERENCES

[1] A. P, Fiske, Structures of Social Life: The Four Elementary Forms of Human Relations Communal Sharing, Authority Ranking, Equality Matching, Market Pricing. Toronto, Canada: Collier Macmillan, 1991.

[2] A. P, Fiske, The Four Elementary Forms of Sociality: Framework for a Unified Theory of Social Relations, Psychological Review, 99, 689–723, 1992.

[3] S. Leśniewski, Leśniewski's Lecture Notes in Logic. Ed. by J. T. J. Srzednicki and Z. Stachniak. Dordrecht: Kluwer, 1988.

[4] S. Leśniewski, 1916. "Foundations of the General Theory of Sets, I", in Stanislaw Leśniewski: Collected Works, S. Surma, Stanislaw et al. Eds. [Nijhoff International Philosophy Series, 44] Dordrecht: Kluwer Academic Publishers,129–173, 1992.

[5] G. O. Langford, Engineering Systems Integration: Theory, Metrics and Methods. Boca Raton, Florida, CRC Press/Taylor & Francis, 2012.

[6] G. O. Langford. "System of Systems Process Model," Chapter 7, Engineering Emergence: A Modeling and Simulation Approach, L. Rainey and M. Jamshidi, Eds. Boca Raton, Florida: CRC Press/Taylor & Francis, 2018.

[7] G. O. Langford and T.S-E. Langford, "The making of a system of systems: Ontology reveals the true nature of emergence," in Conf. Proc. 12th Annual System of Systems Engineering Conference IEEE Int., 2017.

[8] G. O. Langford, "Toward a General Theory of Systems Integration: Research in the Context of Systems Engineering," Ph.D. dissertation, Defence and Systems Institute, School of Electrical and Information Engineering, University of South Australia, Mawson Lakes, Australia, 2013.

[9] P. M. Simon, Parts: A Study in Ontology. Oxford, Clarendon Press, 1987.

[10] B. Smith and A. C. Varzi,, "Fiat and Bona Fide Boundaries," Philosophy and Phenomenological Research 60(2), pp. 401–420, 2000.

[11] G. Guizzardi, Ontological Foundations For Structural Conceptual Models, CTIT PhD Thesis Series No. No. 05-74, Telematica Insituut Fundamental Research Series, Centre for Telematics and Information Technology, 015 (TI/FRS/015), Enschede, The Netherlands, 2005.

[12] C. M. Keet, A Formal Theory of Granularity: Toward Enhancing Biological and Applied Life Sciences Information Systems With Granularity Computer Science Department. Free University of Bozen-Bolzano, Bozen-Bolzano. Ph.D.: 268, 2008.

[13] G. O. Langford, "System of Systems Process Model," Chapter 6, Phenomenological and Ontological Models for Predicting Emergence, L. Rainey and M. Jamshidi, Eds. Boca Raton, Florida: CRC Press/Taylor & Francis, 2018.

[14] G. O. Langford. "Verification of requirements: system of systems theory, framework, formalisms, validity. 27th Annual INCOSE International Symposium," IS 2017, International Council on Systems Engineering, Adelaide, Australia, July 15-20, 2017.

[15] G. O. Langford, "Verification of Requirements: System of Systems Theory, Framework, Formalisms, Validity," 27th Annual INCOSE International Symposium (IS 2017), Adelaide, Australia, July 15-20, 2017.

[16] L. von Bertalanffy General System Theory: foundations, development, applications. New York, George Braziller, 1968.

[17] C. A. Gurr, "Effective Diagrammatic Communication: Syntatic, Semantic and Pragmatic Issues", Journal of Visual Languages and Computing, 10, 317-342, 1999.

[18] J. F. Sowa, Knowledge Representation: Logical, Philosophical, and Computational Foundations. Pacific Grove, CA, Books/Cole, 2000.

[19] G. H. Lewes, Problems of Life and Mind. Boston: James R. Osgood and Company, 1875.

[20] G. O. Langford, and T. Ferris. 2014. A Systems Thinking Society: Integrative Framework for Technology. The International Journal of Technology, Knowledge and Society. Common Ground, ISSN # 1832-3669.

[21] F. P. Bowden and D. Tabor, "Mechanism of Metallic Friction," Nature, vol. 150, 197-199, August 1942.

[22] G. O. Langford, "Maintenance Scheduling Using Systems Engineering Integration," in Conf. Proc., 2016, 26th Annual INCOSE International Symposium (IS 2016), Edinburgh, Scotland, UK, 18-21 July, 2016.

[23] G. O. Langford, J. R. Carpenter, L. Beaulieu, I. Watkins, B. Marsh, C. Chase, and T. Heidorn, "Intelligent Systems in Space," Paper 19R0266, Portland International Center for Management of Engineering and Technology (PICMET), Technology Management in the World of Intelligent Systems, 25- 29 August 2019.

[24] G. Schiuma, D. Carlucci, and F. Sole, "Applying a systems thinking framework to assess knowledge assets dynamics for business performance improvement," Expert Systems with Applications, 39, 8044-8050, 2012.

[25] M. Zafirovski, Social Exchange Theory under Scrutiny: A Positive Critique of its Economic-Behaviorist Formulations, Electronic Journal of Sociology, ISSN: 1198 3655, 2005.

[26] G. D. Peterson, G.S. Cumming, S.R. Carpenter, "Scenario Planning: a Tool for Conservation in an Uncertain World", Conservation Biology, Vol. 17, No.2, April 2003.

[27] H. Kahn, W. Brown and L. Martel, The Next 200 Years: A Scenario for America and the World. New York, William Morrow, 1967.

[28] H. Kahn, "The Alternative World Futures Approach." In F. Tugwell, (Ed.), Search for Alternatives: Public Policy and the Study of the Future. Cambridge Massachusetts: Witrop Publishers, 1973.

[29] R. K. Zachary, The importance of the family system in family business, Journal of Family Business, 1(1), 26–36, 2011.

[30] T. H. Davenport, L. Dalle-Mule, J. Lucker, "Know What Your Customers Want Before They Do," Harvard Business Review, Dec 2011.

[31] J. T. Gourville, "Eager Sellers and Stony Buyers: understanding the psychology of new-product adoption," Harvard Business Review, Jun 2006.

[32] J. Quelch and K. Cannon-Bonventre, "Better Marketing at the Point of Purchase," Harvard Business Review, Nov 1983.