Time out politics: transforming time into space

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Abstract

Sustainable development is absolutely necessary for a viable human future, which corroborates the need for diverse, society-specific cultures across the globe. Cultural diversity enhances the human entelechy in us for personal vitality, institutional invigoration and viable socioeconomic development as well as morality, human integrity, societal solidarity, cooperation and amicable human and organizational relations. The purpose of this research is to test a theoretical sustainable development framework, using the system dynamics (SD) modeling method. The experimental results show how the administrative and political systems in and about all of us live and work transform time into space, through a transition from system structure and dynamics to focusing all attention on one-time events, manifested as systemic discontinuities through time. Cast as a methodological application too, the article also shows the use and benefits of formal SD model analysis.

Keywords: political systems, sustainable development, system dynamics (SD)

A normative tenet within our system dynamics (SD) community urges us to shift our focus from one-time events to through-time behavior patterns and to system structure. By system structure we mean the structure of invisible cause-and-effect relations that form circular feedback loops, which drive system behavior through time (Meadows 1989, Sterman 2000, p. 16). Yet, the administrative and political systems in and about all of us live and work seem to always do precisely the opposite. Not only do they ignore system structure and the dynamics, i.e., through-time behavior patterns, of systems, and thereby focus all of their and our attention on one-time events, but they also seem to transform time into ugly spaces through one-time events, as they create ugly, systemic discontinuities through time.

This could be perhaps because the eminently natural, dynamic movement of our cosmos scares phobic people. Its eternal kinesis makes the risk-averse deny its continuous metamorphosis, denouncing all that constitutes a supposedly frightening 'unknown' future. Fear about what exactly that unknown is, incorporates the great fear of the loss of our ego, the ultimate fear, the fear of death. All this at a time when nothing short of a radical societal transformation is needed to reverse the downhill, free-fall trends that all of us –phobic or not– see in our business, economic, educational, financial, societal and political systems in our modern temporality.

Indeed, the data are in (Friedman 2011, Krugman 2011, Paxman 2011). As they erupt from Tunisia to Tel Aviv to Wall Street, people's protests show that a societal metamorphosis is happening globally that needs defining. People cannot take it any more. Some say it is all part of the big shift: our system of financial crises, ineffective 'democracy' and overloading planet Earth –our system– is eating itself alive. It is broken. Are we better off if we let it work, if we let the rich get richer fast at the expense

of the rest of us, if we let corporations focus only on wealth accumulation, if we let pollution go unchecked? When the Occupy Wall Street (occupywallst.org) protests began, most news organizations were derisive if they deigned to mention the protests at all. What can we say about them? A useful critique of the protests is the absence of specific societal and political demands. Rich Yeselson, a veteran organizer and historian of societal movements, has suggested that debt relief for working Americans has become a central plank for the protests (Wolff 2012).

Hydrogen accumulation can cause the worst-case, 'China-syndrome' scenario to play in Fukushima, which, together with the Gulf of Mexico disaster makes a perfect example of the dire consequences of brutal cost cutting in our modernity. In their incisive prognosis of America's economic meltdown, Melissaratos and Slabbert (2009) conclude that science-challenged America must reclaim its hellenic roots. Likewise, Hiwaki (2011, 2012) argues that a viable human future necessitates sustainable development that in turn requires soundness of diverse society-specific cultures across the globe.

That and perhaps infrastructure and technology investments –not just debt or tax cuts– can help create new jobs, a vexing research topic that Zeleny (2012) deals with explicitly. Meanwhile, in glorious Hellas and Italy, the governments of the bankers fell. That is the good news. The bad news is that, hereinafter, the bankers govern themselves. Back in the USA, taking Buffett's (2011) cue, along with Rawls' (1999) theoretical backing, President Obama proposed a 'millionaire tax' (Calmes 2011). In an orwellian fashion, some Americans denounce it as a 'class war'. The truth is, however, that the super-rich have already won the war (Wolff 2012). The incoming data could indeed be informing us of the beginning of a global revolution. But it is a knowledge revolution that this article advocates for our much troubled modern temporality.

Just as Hiwaki (2011, 2012) advocates our urgent need toward a paradigm shift for sustainable development. Hiwaki and Tong (2006) urge us to take appropriate measures against an encroaching 'credibility trap' in most of the advanced and advancing countries. It seems that as long as we follow our global civilization-market economic activities, we can easily fall very soon into this *credibility trap*: a long-term, severe societal lethargy and loss of personal, organizational and social entelechy. Any and all thinkable appropriate measures against such a severe predicament must counter-balance our global civilization-market activities by starting vigorously to enrich the respective holistic cultures—the very source of human entelechy. The SD model in this article shows the possible effects of such cultural enrichment, in terms of Hiwaki's societal value and material interactions that replicate his simplified theoretical framework for sustainable socioeconomic development.

The derivation of a summary expression for Hiwaki's basic theoretical construct is elaborated in his life's work (2011, Appendix: the retrogression and breakdown processes). The SD simulation model that this article presents draws heavily on Hiwaki's work in order to test some of the assumptions behind

his sustainable development framework, using the SD modeling method (Forrester 1958, Sterman 2000). Cast as a methodological application too, the article also shows the use and benefits of SD model analysis with Mojtahedzadeh's (1996) pathway participation metric (PPM), implemented in his Digest® software (Mojtahedzadeh, Andersen and Richardson 2004).

The experimental results show that three feedback loops become prominent in generating the model dynamics, all balancing or negative (–) loops. The article does not merely translate Hiwaki's theoretical work into a SD model to replicate research results. It dares to ask how and why the model produces the results it does. With the help of the PPM, the article ventures beyond *dynamic* and *operational thinking*, seeks insight from system structure and thereby accelerates *circular causality thinking* (Richmond, 1993). The PPM helps detect exactly how changes in loop polarity and prominence determine sustainable development performance.

Background research

Those of us who use the SD modeling method are not alien to the idea of sustainable development. Harich (2010), Jones, Seville and Meadows (2002), Moxnes (2000), Otto and Simon (2008) and Randers (2000) are some of the SD researchers who have made valuable contributions to sustainable development SD research and practice. To give but one example, Otto and Simon (2008) use a cultural framework derived from anthropology as they extend previous system dynamics research on online community networks. There even was a Special Issue of the *System Dynamics Review* on sustainable development (Saeed and Radzicki 1998). Yet, the *UN Brundtland Commission's* 1987 definition of sustainable development still seems to hold as: "... development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (*cf* Goffman 2005).

According to Hiwaki (2011, 2012), a perpetual enrichment of cultural diversity across the world can provide the needed enriched foundation for human vitality, morality, cooperation, sound common values and amicable human relations. Such enriched cultures also provide a constantly reinforced 'stable bridge' over the past, present and future of our respective societies. Constructive elements of civilization do of course contribute to our cultural enrichment, particularly when relevant societies adopt them, within a long-term process of cultural digestion and fitting modifications. It is worth noting that such cultural enrichment is cumulative in the long term and also constructive toward a balanced and integral development of all elements that are beneficial to the respective societies. Our natural, all-embracing human 'entelechy', both in human and in societal terms entails a natural 'vitality' generated continuously by constant and perpetual enrichment of each holistic culture on the surface of our planet. Such enrichment of culture demands an integral process of extra long-term interactions between the all-embracing mother Nature and its human constituents, with our humanity as part of Nature, particularly for the latter's lasting value and material well-being. Hiwaki argues that for the sake of constantly generating,

maintaining and augmenting our human entelechy and vitality in our global age, we must have a clear and common long-term, aspiring purpose that links sustainable development to our viable human future.

And then Hiwaki points out how the *UN Brundtland Commission* later added to its definition that sustainable development "is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs" (*cf* Hiwaki, 2012). To Hiwaki, this implies nothing less than a paradigm shift for the sake of promoting sustainable development that will encourage mutual respect among societal constituents for local collaboration as well as among diverse societies for global collaboration.

In turn, collaboration requires what Hiwaki (2009) calls an 'open' democracy, based on a new political-legal principle of 'integrity in diversity'. But our prevailing so-called 'democracy' is of a 'closed' nature, i.e., a democracy closed by our respective national borders, based on the political-legal principle of 'unity in diversity' that necessitates a strong power of 'national interest' to standardize and unify us, the people, for a rather short-term and shaky practice, with a very strict and strictly artificial low-abiding πολιτεία or politeia (~state). Our prospective global community may require a borderless 'open' democracy, argues Hiwaki (2009, 2012), with voluntary collaborations of all peoples and societies on the basis of 'integrity in diversity'. All the above important issues require, no doubt, a paradigm shift: a perpetual sound enrichment of diverse cultures across the world.

Aristotle teaches caution about such assumptions. He advocates moderation and measure in life, defining *αρετή* or virtue as the rational pursuit of a mean between harmful extremes. Excess is bad in itself (Dierksmeier and Pirson 2009, Karayannis 2007). Modern economists often dismiss Aristotle, Plato and Xenophon because the ancients did not observe certain features of our modern market economy, essential to contemporary scholars, e.g., Schumpeter (1954). The Hellenes, as well as most thinkers of the old Occident and Orient have little to say on marginal utility theory and the non-zero-sum games of modern trade (Solomon 2004, p. 1023]. But it might just be too easy to dismiss them for this reason. In Aristotle's *Eudemian* and *Nicomachean Ethics*, as well as his *Parts of Animals* and *Politics*, Dierksmeier and Pirson (2009, p. 421) see a political framework of 'unity-in-diversity' too.

Yet, in order to accomplish sustainable development through worldwide collaborative endeavors, we must often ask how to develop a globalized *relational mutuality*, with shared aspirations and common long-term interests, in a viable human future, given the lopsided explosive ideologies of civilization in our modern temporality. To Hiwaki (2012), such ideologies leave a bad aftertaste of materialism, progressivism, individualism, liberalism, expansionism, reductionism, egotism, antagonism and so on, as they are largely represented by market competition, economic growth, liberal and libertarian 'democracy', profit-and-utility maximization, individual self-interest and the 'money-is-might-that-makes-right' idea.

The aggressive, widespread vested interests in the lopsided ideologies reinforce self-seeking, profit-oriented, growth-maniac and power-hungry human relations and connections in politico-economic and socio-educational spheres on the surface of our planet. Such aggressive vested interests and pervasive ideologies damage the hoped for culture-embraced relational mutuality or "art of relational living" (Hiwaki 2012), in our respective societies. Such damage or loss can be recovered only by perpetually enriching the respective cultures across our world.

Presently thinkable appropriate measures against a severe predicament, such as the credibility trap is, must counter-balance the civilization-market activities by starting vigorously to enrich the respective holistic cultures—the very source of human entelechy. The SD model in this article shows the possible effects of such cultural enrichment, in terms of Hiwaki's *value* and *material* interactions that replicate his simplified theoretical framework for sustainable socioeconomic development. The derivation of a summary expression for Hiwaki's basic theoretical construct is elaborated in his life's work (2011, Appendix: the retrogression and breakdown processes).

Briefly, however, Hiwaki builds his sustainable development theory around what can be seen as the dynamic interactions between the 'value-aspect' and the 'material-aspect' components of human life. The *value-aspect* component represents the dynamics of human culture or cultural enrichment, while the *material-aspect* module reflects the dynamic, socioeconomic activities' reactions to cultural enrichment for a sustainable socioeconomic development. The value-aspect part shows the on-going interactions of a societal trend preference rate, which represents the long-term society-general time-preference, with a society' sensed rate R showing the long-term economy-specific time-preference. The material-aspect part includes the cumulative or integral variable B, summarily representing the long-term aggregate economic variables and performance metrics, including the long-term, all encompassing aggregate, both market and non-market value added.

Hiwaki's virtuous circle of the value-material interactions entail an untiring endeavor for cultural enrichment, which brings about a psychological change in a society's time frame and enhances people's positive future orientation. Hiwaki assumes that one cannot easily develop without a cultural foundation or totally detached from one's native culture, as it provides the mother tongue, mores, spirit, knowledge, wisdom, insights, ingenuity and relational mutuality, among other valuable things. Such a solid cultural foundation can be naturally inter-related with foreign cultures, toward a dynamic and comprehensive human development. Consequently, a culture can acquire further stimulation to enrich itself, and the enriched culture becomes in turn the basis for further human development.

Hiwaki moves to represent the future orientation of an enhanced society-general symbolically by a decline of the societal sensed trend, equivalent to a decline in the society's present-time preference. The resultant change in the society's present time frame then affects coherently, but not equivalently, the time

frame of its socioeconomic activities through time. Hence, the enhanced orientation toward the future of societal constituents induces a somewhat lagged but coherent decline of the society's sensed state R. The lagged downward movement of the economy-specific time-preference rate shows the enhanced society's economy-specific future orientation. Alternatively put, the enhanced future orientation, i.e., people's psychological change that places greater emphasis on the future, of a society-general shows a decrease in its sensed trend, which encourages a lagged coherent decline in its sensed state R.

Concurrently, the enhanced society-general future orientation may increase B, a variable implying the systemic and synergistic growth of the long-term aggregate economic variables and performance metrics, summarily representing both market and non-market value added. A growing B implies growth of investment in the human-and-material capital. Such growth in investment can stimulate the synchronous processes of comprehensive human development, balanced socioeconomic development and sound cultural enrichment, expanding the societal long-term aggregate value-added, which encompasses all goods and services produced and transacted both in markets and by other means. Also, the investment increase can enlarge the stock of human and material capital through time and appreciate the economy-specific future orientation, thereby shifting the societal sensed state R further downward. The declining R can in turn influence the society-general future orientation, by also shifting the societal sensed trend downward.

Meanwhile, the expanded all-encompassing societal value-added of socioeconomic development feeds back to B thereby simultaneously increasing aggregate performance metrics through time. The grown in B can now enhance both the economy-specific and society-general future orientation, thereby inducing what Hiwaki calls a 'trilateral' virtuous circle among balanced socioeconomic development, holistic culture enrichment and comprehensive human development. The on-going dynamic enrichment of culture can now reinforce the long-term future orientation of societal constituents, inducing a further decline in the societal sensed trend.

The SD simulation model in this article shows an interpretation of as well an attempt to test some major assumptions underneath Hiwaki's sustainable development framework. Following Hiwaki, the model consists of two interdependent model sectors: the *value-aspect* model sector and the *material-aspect* model sector. Different sets of computed scenarios allow producing experimental results that seem to corroborate, at least in part, some of Hiwaki's descriptive and normative arguments. Then the use of formal SD model analysis helps determine which prominent causal pathways dominate the interdependent societal value-aspect and economic material-aspect dynamics. *First*, however, what follows is a very brief overview of formal SD model analysis.

Model analysis in the SD modeling method

SD formally links system structure and performance. In order to help academics, managers and policy makers see exactly what part of system structure affects its performance through time, i.e., detect shifting loop polarity and dominance (Richardson, 1995), SD researchers use tools from discrete mathematics and graph theory, first to simplify and then to automate model analysis (Gonçalves Lerpattarapong and Hines 2000, Kampmann 1996, Mojtahedzadeh 1996 and 2011, Mojtahedzadeh *et al*. 2004, Oliva 2004, Oliva and Mojtahedzadeh 2004). Mostly, they build on Nathan Forrester's (1983) idea to link feedback loop strength to system eigenvalues.

The PPM plays a crucial role in the analysis of this article's model. It detects and displays prominent causal paths and loop structures by computing each selected variable's dynamics from its slope and curvature, i.e., its first and second time derivatives. Mojtahedzadeh (2011) and Mojtahedzadeh *et al*. (2004) give an extensive overview of the PPM that shows its conceptual underpinnings and mathematical definition, exactly how it relates to system eigenvalues, and concrete examples to illustrate its merits and limitations. Briefly, using a recursive heuristic approach, the PPM detects compact structures of chief causal paths and loops that contribute the most to the performance of a selected variable through time. It first slices a selected variable's time path or trajectory into discrete phases, each corresponding to one of eight possible behavior patterns through time.

Eight archetypal performance dynamics, i.e., behavior patterns through time, can exist within a single time phase of behavior for a single selected variable of interest: 1) balancing growth, 2) reinforcing growth, 3) balancing decline, 4) reinforcing decline, 5) linear growth, 6) linear decline, 7) static equilibrium and 8) dynamic equilibrium (Mojtahedzadeh *et al*. 2004). Once the selected variable's time trajectory is cut into time phases, the PPM determines which causal pathway is most prominent in generating that variable's performance, within each time phase. As causal paths combine to form feedback loops, combinations of such circular paths shape the most influential or prominent loops within each phase. Through its formal SD model analysis segments, this article contributes to the methodological stream of SD research on the PPM applications and value (Mojtahedzadeh 2011, Mojtahedzadeh *et al*. 2004, Oliva and Mojtahedzadeh 2004).

Model description

Built around Hiwaki's (2011, 2012) sustainable development framework, the SD simulation model consists of two interdependent model sectors: the value-aspect model sector (Fig. 1 and Table 1) and the material-aspect model sector (Fig. 2 and Table 2). Within Hiwaki's sustainable socioeconomic development framework, the societal trend preference rate is an idea familiar to the SD modeling method, often used in modeling human expectations (Sterman 2000, p. 634).

The value-aspect model sector

Since the two model sectors are interdependent, the input to the value-aspect model sector (Fig. 1) comes from the material-aspect model sector (Fig. 2). The Expected B stock (Fig. 2 and Table 2, Eq. 19), which represents the cumulative or integral rate of consumers' income expectations, set initially to the society's material income B (Fig. 2, Eq. 18), does *feed* (Eq. 9) the societal Sensed Rate R (Fig. 1, Table 1, Eq. 2).

Closely linked to Hiwaki's sensed trend rate, the Sensed Rate R stock shows a society's long-term, economy-specific time preference. This societal time preference depends on the society's cumulative or integral rate of income expectations. The Expected B stock input to the value-aspect model sector gets adjusted first by the interest rate *i* (Eq. 12), as a linear function of *i* multiplied by time (Eq. 9). Then is gets smoothed, assuming a first-order smoothing (Eqs 10, 11, 16 and 5).

It is worth noting at least *two* major concerns about the *time to sense R* auxiliary converter (Fig. 1 and Eq. 16). *First*, even if raw data were available for a society to see instantaneously, government officials and politicians often smooth the reported values, sometimes just to filter out all high-frequency noise. Even if it fits a society's political and socioeconomic development agendas, noise can also arise from forecasting processes, measurement errors as well as from subsequent revisions of the data reported (Syntetos *et al*. 2011).

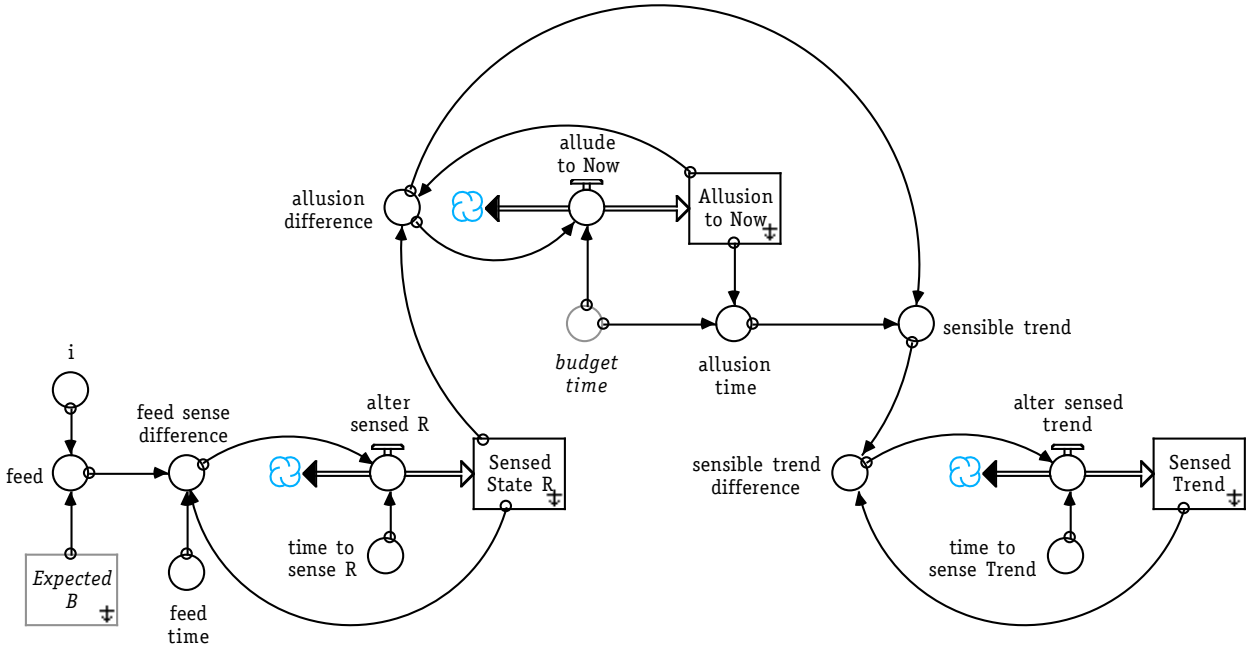

Figure 1. The value-aspect model sector.

Second, it does take time to assess a societal time preference, so the *time to sense R* cannot be less than the measurement and reporting delays that also play a major role in forming a society's

expectations. Business, economic, demographic, environmental and other societal data take time to collect and to report, so at least one quarter of a calendar year must be used for this exogenous constant (Eq. 16).

Table 1. The value aspect model sector equations.

Level (state) or stock variables {unit}	*Eq. #*
Allusion to Now(t) = Allusion to Now(t - dt) + (allude to Now) * dt	1
INIT Allusion to Now = Sensed State R / (1 + Sensed Trend * budget time) {US$}	1.1
Sensed State R(t) = Sensed State R(t - dt) + (alter sensed R) * dt	2
INIT Sensed State R = (feed * budget time) / (1 + Sensed Trend * time to sense R) {US$}	2.1
Sensed Trend(t) = Sensed Trend(t - dt) + (alter sensed trend) * dt	3
INIT Sensed Trend = 0 {1 / year}	3.1
Flow or rate variables {unit}	
allude to Now = allusion difference / budget time {US$ / year}	4
alter sensed R = feed sense difference / time to sense R {US$ / year}	5
alter sensed trend = sensible trend difference / time to sense Trend {1 / year / year}	6
Auxiliary or converter variables and constants {unit}	
allusion difference = Sensed State R - Allusion to Now {US$}	7
allusion time = Allusion to Now * budget time {US$ * year}	8
feed = Expected B * (1 + STEP ((i * TIME), 6)) {US$ / year}	9
feed sense difference = feed - Sensed State R / feed time {US$ / year}	10
feed time = 1 {year}	11
i = -0.08 {1 / year}	12
sensible trend = allusion difference / allusion time {1 / year}	13
sensible trend difference = sensible trend - Sensed Trend {1 / year}	14
time to allude to Now = 1 {year}	15
time to sense R = 0.25 {year}	16
time to sense Trend = 0.25 {year}	17

Having addressed these concerns, a given society's members and decision makers compare the society's long-term, economy-specific time preference to its past values, here quantified by the society's Allusion to Now (Fig. 1, Eq. 1). This last stock is an exponentially weighted average of the past values of the sensed trend interest rate or Sensed State R stock. It represents the value of the Sensed Rate R stock, one budget time period in the past. Set up for automatic steady-state initialization, Allusion to Now helps the society as a whole determine whether its cumulative, economy-specific income rate is either rising or falling through time. The society alludes to now, the present time, again through a first-order exponential smoothing of Hiwaki's sensed trend interest rate: Sensed Rate R.

The time horizon for the society's Allusion to Now is non other than the society's national budget time (Eq. 23, Table 2). A one calendar year is a historical time period that most government officials and politicians would consider adequate for the society they represent and work for to allude to now, its current or present decision situation. Alternatively, one can think of 1/budget time (Eq. 4) as the rate at which the society discounts past values of its long-term, economy-specific time preferences.

In addition to helping compute a society's Allusion to Now, the *allusion difference* between Sensed State R and Allusion to Now (Eq. 7), also helps determine that society's *sensible trend* as the ratio of the *allusion difference* divided by the *allusion time* auxiliary parameters (Eq. 13). Which in turn allows

computing the final output of the value-aspect model sector (Fig. 1), the Sensed Trend stock that represents a fractional growth rate per year (Eqs 3 and 3.1).

The *sensible trend difference* between *sensible trend* and the Sensed Trend (Eq. 14) is the difference between the society's sensed trend interest rate or Sensed State R and its Allusion to Now, expressed as a fraction of the society's Allusion to Now and then divided its economy-specific budget time. The *sensible trend difference* does provide up-to-date information on the most recent rate of change in the society's Allusion to Now but, generally, societal perceptions and values do not adjust instantly to new information.

The Sensed Trend stock of the value-aspect model sector (Fig. 1) permits a society's perceptions and values to adjust gradually to changes in its material, economy-specific aspects. A first-order information smoothing takes place once more (Eqs 13, 14 and 6), with a time delay now determined by the *time to sense Trend* parameter (Eq. 7), set equal to the time *to sense R* parameter (Eq. 16). Following the same rationale as above about the timeliness of the information, this lag in the Sensed Trend entails the minimum time required for a change in the sensible trend to alter the sensed trend that government officials and politicians subsequently use to influence their society's material, economy-specific aspects (Fig. 2). Again, the initial values of the Allusion to Now and the Sensed State R stocks are set to initialize the value-aspect model sector in steady state, irrespective of the entire model's exogenous input constant parameters.

The material-aspect model sector

The material-aspect model sector on Fig. 2 shows a dynamically complex yet simple, i.e., uncomplicated, macroeconomic multiplier model that relies heavily on research contributions by Samuelson (1939), Low (1980) and Sterman (2000, p. 719). Compatible with Keynesian economics, the model shows how a society's economy-specific spending on goods and services depends on people's expectations of their future income or, alternatively, the Expected B stock (Fig. 2 and Eq. 19, Table 2).

Hiwaki's (2011) sustainable development framework looks at the cumulative or integral income rate variable *B* (Eq. 18) as the result of a society's dynamic, socioeconomic reactions to cultural enrichment for a balanced socioeconomic development. While spending on goods and services depends on future income expectations, the society's Expected B in turn depends on its cumulative income rate *B*. Assuming that a society's entire population is involved, one can think of Hiwaki's *B* as the equivalent of the society's economy-specific gross domestic product (GDP).

In addition to the two minor, nested feedback loops on Fig. 2, the large, outer feedback of the material-aspect model sector is a positive or reinforcing loop, which acts as Samuelson's consumption or spending multiplier. An increase in *B* both improves income and raises spending, further increasing *aggregate spending* (Eq. 22) and the cumulative or integral rate variable *B*.

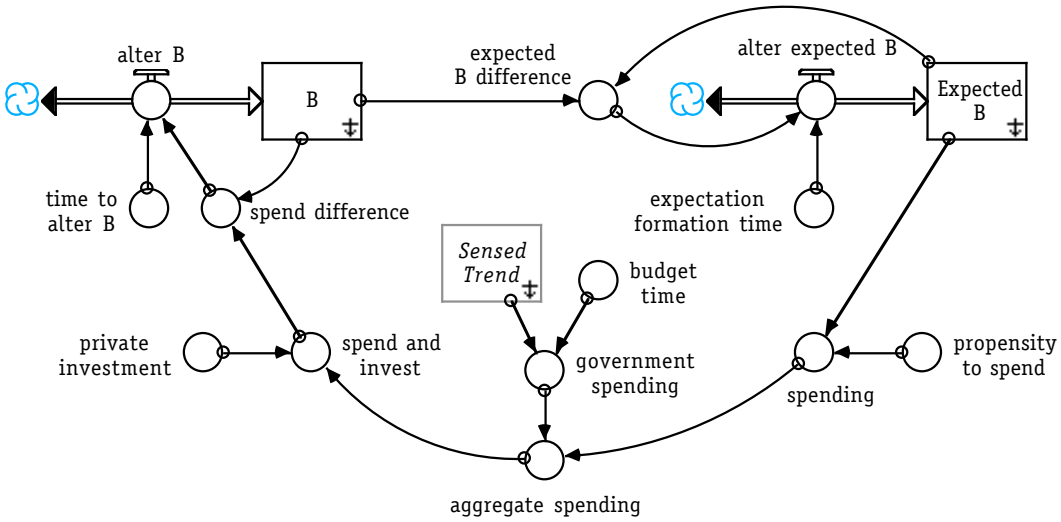

Figure 2. The material-aspect model sector.

Table 2. The material-aspect model sector equations.

Level (state) or stock variables {unit}	Eq. #
B(t) = B(t - dt) + (alter B) * dt	18
INIT B = (private investment + government spending) / (1 - propensity to spend) {US$ / year}	18.1
Expected B(t) = Expected B(t - dt) + (alter expected B) * dt	19
INIT Expected B = B {US$ / year}	19.1
Flow or rate variables {unit}	
alter B = spend difference / time to alter B {US$ / year / year}	20
alter expected B = expected B difference / expectation formation time {US$ / year / year}	21
Auxiliary or converter variables and constants {unit}	
aggregate spending = spending + government spending { US$ / year}	22
budget time = 1 {year}	23
expectation formation time = 2 {year}	24
expected B difference = B - Expected B {US$ / year}	25
government spending = 90 * (1 + Sensed Trend * budget time) {US$ / year}	26
private investment = 10 {US$ / year}	27
propensity to spend = 0.8 {unitless}	28
spending = Expected B * propensity to spend {US$ / year}	29
spend and invest = aggregate spending + private investment {US$ / year}	30
spend difference = spend and invest - B {US$ / year}	31
time to alter B = 1 {year}	32

Glaringly absent from this simple model are society's economy-specific inventories and supply chains, so the time to *alter B* is rather short (Eq. 32). And future cumulative income expectations, i.e., the Expected B stock, also adjust with a delay to the actual income *B* (Eq. 24). As the total production flow of goods and services adjusts to *alter B* (Eq. 20), with its short delay (Eq. 32), it does indeed *alter B* through a first-order smoothing process (Eqs 20 and 31), a rather common assumption in macroeconomic models. Likewise, a first-order smoothing process feeds the Expected B stock (Eqs 24, 25 and 21).

Despite the minor, nested feedback loops, which contribute to the model's dynamic complexity, in addition to the time constant parameters (Eqs 23, 24 and 32), both the *private investment* and the *propensity to spend* parameters (Eq. 28) are exogenous too. Yet, another interesting model sector feature

is that, while the two stocks' initial conditions are individually sensible, together they create what Sterman (2000, p. 719) calls: "a simultaneous initial value equation" situation, as Eqs 18.1 and 19.1 clearly show.

Experimental results

Figure 3 shows four computed scenarios for the societal Allusion to Now stock through time. Having initialized the entire SD model at steady state, the simulation results show a dynamic equilibrium behavior until time = 6 (years). Then the *feed* converter variable (Eq. 9, Table 1) perturbs the system from its dynamic equilibrium, thereby altering the dynamic behavior of the societal Allusion to Now stock, depending on the values that the *i* parameter (Eq. 12) takes.

As the *i* parameter values increase from -0.08 to 0.08, the societal Allusion to Now changes from a set of declining behavior patterns through time to increasing dynamics. Whether rising or falling, in the long term, the societal Allusion to Now does so linearly. In the short term, however, its behavior patterns show some most interesting, non-linear transition dynamics, including a rather abrupt kink under scenario or run #1 on Fig. 3. More about this later, however, in the *feedback-loop structure or SD model analysis* sub-section that follows below.

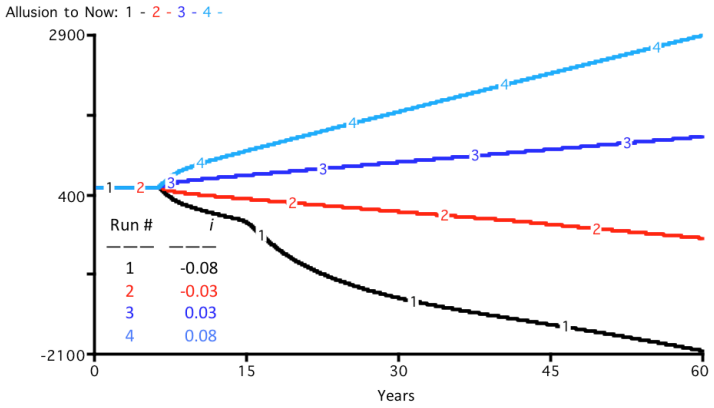

Figure 3. Computed scenarios for the societal Allusion to Now stock through time.

Figure 4 shows two phase plots that, like all phase plots do, they hide the time dimension. But the little arrows on the phase plot of Fig. 4a show its direction, as the relation between the material-aspect stocks B and Expected B transitions to a new dynamic equilibrium, once the system gets perturbed from its initial dynamic equilibrium at time = 6 (years). The abrupt change triggers an initial decline in both B and Expected B, causing both income and spending to decline too but, after the systemic discontinuity on the lower left corner of Fig. 4a, both B and Expected B start rising again, with B making it so faster than the Expected B stock. Once societal future income expectations catch up with the rising actual income (on the middle-right of Fig. 4a), then they continue to increase, while B begins to decline. But a society is

prone to eventually lower its future income expectations too, so that both B and Expected B begin to decline in tandem, linearly, until the relation between the material-aspect stocks B and Expected B transitions to its new dynamic, sustainable equilibrium, shown slightly above its initial dynamic equilibrium on the lower left corner of Fig. 4a.

Most interestingly, the phase plot on Fig. 4b seems to confirm Hiwaki's (2012) theoretical construct for sustainable development. Specifically, Hiwaki expects an extra long-term schedule of the dynamic interaction between the Sensed State R and the Sensed Trend stocks to take the form of the 'bow-like' ODP curve on Fig. 4b. Alternatively put, the continuous interactions between a society's acceleration of its future orientation, i.e., a declining Sensed Trend through time, and the lagged future orientation of an economy-specific domain, i.e., a declining Sensed State R, produce the 'bow-like' ODP dynamics. Such an analogical path is Hiwaki's theoretical and normative representation of sustainable socioeconomic development, which this model in part corroborates, according to the 45° assumption of the lead-lag interactions between the societal Sensed State R and Sensed Trend stocks on Fig. 4b.

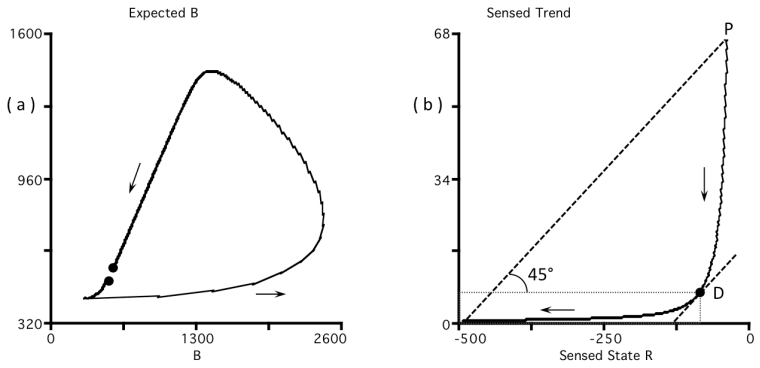

Figure 4. Phase plots for i = -0.08: a) B vs. Expected B and b) Sensed State R vs. Sensed Trend.

Recall that rather abrupt kink under scenario or run #1 on Fig. 3? Figure 5 shows many more abrupt kinks, under its new set of four computed scenarios for the societal Sensed Trend stock. Initially, until time = 6 (years), the simulation results again show a dynamic equilibrium behavior pattern. Then the *feed* converter variable (Eq. 9) perturbs the system from its dynamic equilibrium, thereby altering the dynamic behavior of the societal Sensed Trend stock, depending once more on the now different values that the *i* parameter (Eq. 12) takes.

As the values that the *i* parameter (Eq. 12) now takes decline from -0.08 to -0.02, the societal Sensed Trend stock shows a whole set of systemic discontinuities, caused by the dynamic interdependence of the SD model's feedback loops. The feedback-loop structure or SD model analysis sub-section below details which of the model's feedback loops become most prominent as they cause the fascinating dynamics that the societal Sensed Trend stock shows on Fig. 5.

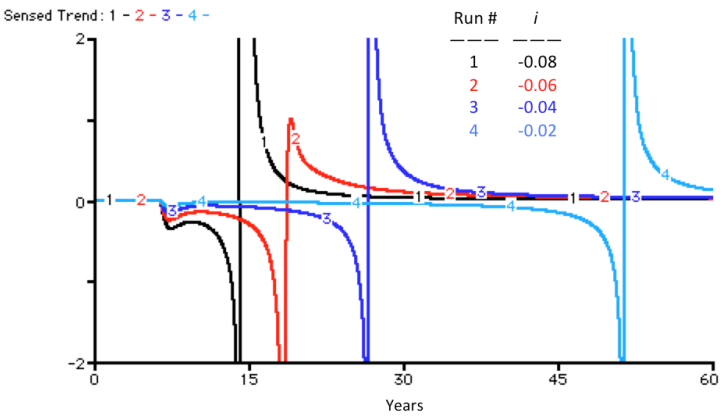

Figure 5. Computed scenarios for the societal Sensed Trend stock through time.

It is worth noting for now that, as the *i* parameter values increase from -0.08 to -0.02, they push the systemic discontinuity in the societal Sensed Trend stock farther and farther into the future. Alternatively put, the higher the decline in both the value-aspect and the material-aspect of a society is, the more likely it is to cause a systemic discontinuity early on in the societal Sensed Trend stock. Figure 6 shows the pronounced effect that an increase in both the value-aspect and the material-aspect of a society might have on pushing an abrupt systemic discontinuity in the societal Sensed Trend stock farther into the future. When i = -0.08, then the systemic discontinuity in the societal Sensed Trend stock occurs at time t = 14 years, but when the society's negative trend increases to a value of i = -0.02, then the systemic discontinuity in the societal Sensed Trend occurs at time t = 52 years.

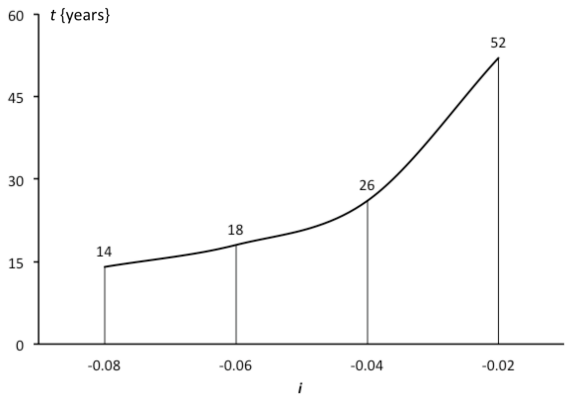

Figure 6. Putting off the political transformation of time into space.

It is understandable why a society in our modern temporality might attempt to push cathartic discontinuities far into the future. The political systems in and about which we all live have been designed to ignore system structure and the dynamics it generates. They try so hard to focus all of their and our

attention on one-time events, but they also seem to transform time into ugly spaces through one-time events, as they create ugly, systemic discontinuities through time. But at least some of us do persist!

Feedback-loop structure or SD model analysis

The pathway participation metric helps detect and confirm the shifting link polarity and prominence of the feedback loops that determine the dynamics seen in the experimental results. Within each sector, model's stocks are embedded in multiple feedback loops, with variable loop lengths (Table 3). For example, the societal Allusion to Now stock is embedded within two feedback loops, while the societal Sensed Trend stock within three. And these circular structures entail lengths of 2 and 20 for the societal Allusion to Now stock, and 2, 17 and 20 for the societal Sensed Trend stock, respectively.

Table 3. Feedback loop analysis of the stocks in the entire model.

#	*Stock*	*Number of feedback loops*	*Feedback loop lengths*
1	Allusion to Now	2	2 and 20
2	B	4	2, 8, 17 and 20
3	Expected B	4	2, 8, 17 and 20
4	Sensed State R	3	2, 17 and 20
5	Sensed Trend	3	2, 17 and 20

The feedback loop length of two for the societal Allusion to Now stock means that a change in Allusion to Now will have to go through two variable before it comes back to alter the value of the same stock. Under Phase #4 on Table 4, it is plain to see that an increase in Allusion to Now causes a negative change in the allusion difference converter. Yet an increase in allusion difference will cause the allude to Now flow to rise, thereby feeding the societal Allusion to Now stock.

But in order to appreciate how valuable Mojtahedzadeh's PPM is, it helps to zoom in on the systemic discontinuity that the societal Sensed Trend stock shows (Fig. 7). Recall that the system gets perturbed from its initial dynamic equilibrium at time $t = 6$ years. But the system discontinuity does not occur until the time phase #6 on Table 4, i.e., between $t = 13.25$ and $t = 13.86$ years, when the prominent causal path is the societal Allusion to Now.

Subsequent to the systemic discontinuity in the societal Sensed Trend, when the societal Allusion to Now is the prominent loop, for a short while, under phase #7 and between $t = 13.87$ and $t = 14.66$ years, the societal Sensed Trend pathway becomes prominent. Then again this pathway passes its prominence control back to the societal Allusion to Now under phase #8, but it regains it under phase #9, which ends when all dynamics has been absorbed into an attractor, leaving the system in a sustainable state of negative feedback.

In conjunction with Tables 3 and 4, Fig. 8 shows the time phases and the prominent causal pathways that cause the Sensed Trend stock dynamics (Fig. 7). Despite their short loop length or

'reachability', the three minor feedback loops on Fig. 8 are nested within the much lengthier feedback loops of Table 3. And PPM computes their prominence as it enables us venture beyond *dynamic* and *operational thinking*, seek insight from system structure and thereby accelerate *circular causality thinking* (Richmond, 1993). The PPM helps detect exactly how changes in loop polarity and prominence determine self-organization performance among the most vital system components: the circular feedback loops.

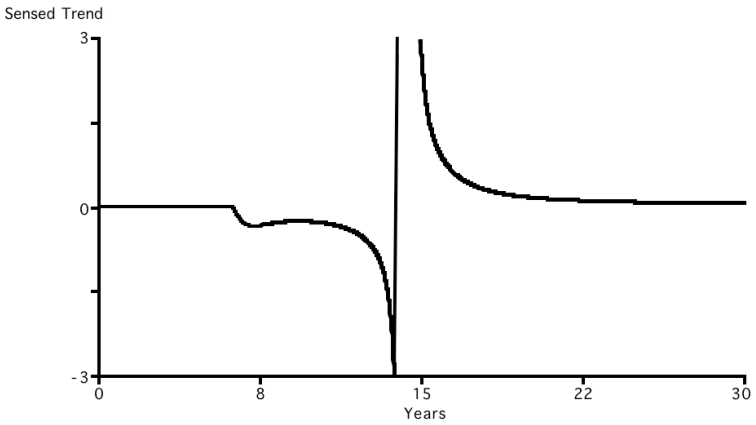

Figure 7. Zooming in on the systemic discontinuity that the societal Sensed Trend stock shows (i = -0.08).

Table 4. Prominent pathways that cause the Sensed Trend stock dynamics.

Phase #	*Time phase interval {year}*	*Prominent pathway* { ⟶ **:** positive (+) causal link and (→) **:** negative (–) causal link }
1	0 to 6	Sensed Trend (→) sensible trend difference ⟶ alter sensible trend ⟶ Sensed Trend
2	6.01 to 6.22	Sensed State R (→) feed sensed difference ⟶ alter sensed R ⟶ Sensed State R
3	6.23 to 6.68	Sensed Trend (→) sensible trend difference ⟶ alter sensible trend ⟶ Sensed Trend
4	6.69 to 7.64	Allusion to Now (→) allusion difference ⟶ allude to Now ⟶ Allusion to Now
5	7.65 to 13.24	Sensed State R (→) feed sensed difference ⟶ alter sensed R ⟶ Sensed State R
6	13.25 to 13.86	Allusion to Now (→) allusion difference ⟶ allude to Now ⟶ Allusion to Now
7	13.87 to 14.66	Sensed Trend (→) sensible trend difference ⟶ alter sensible trend ⟶ Sensed Trend
8	14.67 to 15.18	Allusion to Now (→) allusion difference ⟶ allude to Now ⟶ Allusion to Now
9	15.19 to 30	Sensed Trend (→) sensible trend difference ⟶ alter sensible trend ⟶ Sensed Trend

It is important to keep in mind that these are not *ceteris paribus* results. While the feedback loops on Table 4 and Fig. 8 are the prominent pathways that cause the Sensed Trend stock dynamics, the rest of the feedback loops on Fig. 1 and Fig. 2 are still active, also contributing to the system's dynamic behavior patterns through time.

Discussion and conclusion

Admittedly, Richardson's hair might stand on end with all these exogenous parameters in this article's SD model. Particularly since his latest definition of system dynamics is "the use of informal maps and formal models with computer simulation to uncover and understand the endogenous sources of system behavior"

(2011, p. 241), while systems thinking (ST) entails "the mental effort to uncover the endogenous sources of system behavior (2011, p. 241).

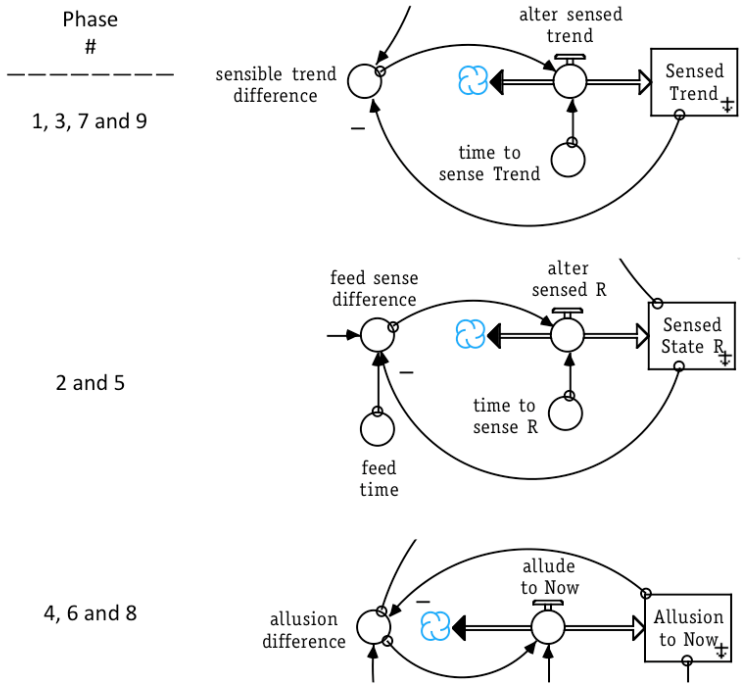

Figure 8. Time phases (left, *sa* Table 4) and prominent loops causing the Sensed Trend stock dynamics.

Thankfully, Mojtahedzadeh's pathway participation metric comes to the rescue, with its analysis of endogenously shifting prominent structure and polarity phases, helping to reveal the SD model analysis results. Indeed, tools such as PPM can help make sense of the dynamically complex structure of SD models, even if Oliva (2004, p. 331) finds SD keen in understanding system performance, "not structure per se", in lieu of its core tenet that system structure causes performance. Undeniably, while looking for *systemic leverage* (Georgantzas and Ritchie-Dunham, 2003), decision makers and modelers do play with structural changes for superior performance. Model analysis tools such as the PPM help articulate structural complexity and thereby enable both effective and efficient strategy designs.

Hiwaki's optimal development path (ODP) for sustainable development, which this study's SD simulation model corroborates on Fig. 4b, suggests much more than a positive, one-directional development process, based on extant sustainable development theories. The ODP path explicitly captures both positive and negative development processes. So it can serve as a dynamic general theory of socioeconomic development, linked to the dynamics (enrichment or impoverishment) of culture and the concurrent socio-psychological alterations of the society-general and economy-specific time frames.

The lead-lag assumption behind Hiwaki's ODP, with no unique and universal point to converge upon through time, gives us a clue toward a dynamic, two-directional development, namely, the positive

processes comprising the P→D growth and the D→O maturation process, as well as the negative processes comprising the O→D retrogression process and the D→F breakdown process. Under this scheme, point D shows the important turning point on the 'bow-like' path, whose slope becomes exactly the same as the '45° ray', implying that both the societal Sensed Trend and the Sensed State R can change at the same rate of change (Fig. 4b).

And Hiwaki does well and good too to raise the issue of the meaning the so-called 'democracy' in our modern temporality. The meaning of this political system has been a vexing issue since the classical Hellas, especially in the way Aristotle treats the subject in his *Politics*. For it has to do with the meaning that the moderns attached to *democracy*. This modern meaning has little in common with what Aristotle stated. If we read his text correctly, democracy is a case of *παρεκβατική πολιτεία* (discursive politeia).

But the moderns, when they tried to free themselves from the shackles of the various despotic governments, they turned to what they thought would serve them as the government of the people by the people and for the people. They used the word *democracy* but not in its original context. To this very day, the modern so-called democracies suffer from a variety of abuses and distortions, in most cases turning into or becoming governments controlled by parties. That being the case, the modern democracies are all… discursive states (Anton 2010).

Without suggesting our modernity's return to antiquity, Georgantzas and Contogeorgis (2012) look at the principles behind Athenians' authentic democracy, which can help our modern temporality metamorphose for the benefit of all concerned. Democracy's multiple equality, liberty and civic-accountability dimension bundles can easily take their role in a multi-perspective dialectic about their dynamic societal implications.

In this context, democracy is seen an ideal, neither painless for nations to practice nor any less painful for business corporations to embrace (Ackoff 1994). Within its evolution from a 'profit-making machine' to a 'biological organization' to a 'social system', the business enterprise continues to depend on the performance of its parts, i.e., functional units and product lines. But the most important aspect of each part's performance is its interactivity with other parts that determines the performance of the enterprise as a whole. As it aims for excellence or forever excelling, i.e., *αίεν αριστεύειν* (aien aristeuein), a firm's managers must seek *αλήθεια* (the truth), *αφθονία* (the plenty), *το αγαθόν* (the good) and *αισθητική* (aesthetics). These are the four 'ontic' dimensions, the hellenic pillars of enterprise development as a societal organization, at least as Ackoff sees them (1994, pp. 49-50).

Is it just a coincidence that, along his advances against global warming, Ólafur Ragnar Grímsson, The fifth President of the Republic of Iceland, refused to let his country's people pay for the damage caused by private companies, namely the banks, and called for a referendum in 2010? "You reach these crossroads, where on the one side there are the financial markets' demands and on the other lays the

people's democratic will. Between these choices, my answer is and always has been clear: the people's democratic will must prevail!", remarks Iceland's President (Avgeropoulos and Kouremenos 2011).

How does a society in our modern temporality experience time and how do modern Hellenes and Italians associate this fact with the current crisis facing their respective countries? And is it yet another coincidence that the official current recession in Hellas is about eight percent, i.e., equal to the *i* parameter value that produces the systemic discontinuity in the societal Sensed Trend stock on Fig. 7? Attempting a connection between a country's *imperium* and *fiscus*, along the idea that the true causes of our fiscal crises can also be culture-specific, it might be useful to persist on time, as well as on our claustrophobic obsession with and insistence on it.

If we understand our past as if it were a museum and we thereby cancel our future, as the purpose of the fulfillment of our desires goes beyond the requirement of work toward future success. The meaning for us of going forward is to restore the past. So rather than open up in time for the future, we passively enclose ourselves in space, either avoiding or constantly deferring our creative outlet to reality. Our aim cannot be to extinguish but to reconcile with out past co-aligning ourselves with the time of our modern temporality.

The political systems in and about which we all live must be re-designed to eliminate the need to transform time into space. Sound cultures can help us stop recycling years of time, without structural changes in order to feel safe. In the end, we end up avoiding public places and politics altogether.

The wisdom of pain ... the evil of ourselves ... we need a clear picture of us, each one but also collectively to form a new self, a unity of societal conscience in a world of constant change, a self image that can and will cope with adversity, a unity consciousness that charges positively and not negatively our experience of time. Only to the extent that we can have a positive experience of time, without transforming it into ugly spaces, i.e., discontinuous points in time, can we sustain a hope for a viable human future, much brighter than our deeply troubled modernity.

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