Eco-Design and Management of Supply Chains: Extended/Virtual-Corporation Innovations

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Abstract- **The ecology globalisation is defy, requiring defining strict technical targets, once aming at sustainable growth goals. The engineer's activity is a central reference in the challenge, with a series of innovative opportunities, which include the ‹product-service› delivery, the ‹sustainable corporation› institute, the ‹lifecycle conformance certification› account and the other specific operation context details. These supply essential tools and techniques permitting the project management accomplishment.**

Keywords- Eco-Project; Lifecycle Management; Service/Recovery Liability; Extended/Virtual Enterprise

I. INTRODUCTION

Eco-sustainability requires lifecycle responsibility of the delivered products-services, resorting to ‹extended enterprise› layouts, endowed of a fit *product-lifecycle-manager* (PLM), i.e. entering *service-engineering* (SE) and *reverse-logistic* (RL) tools. The issues belong to industrial domains; they depend on the ability of devising application-driven rigs, rather than simply transferring technology-driven options [03], [24], [46], [58], [68], [79], [97], [116]. Function consistency and operation efficiency require lifecycle design and integrated management; the former implies information-intensive framework to keep centrality of task-orientation and to monitor investment return in added value; the latter means simultaneous engineering to combine goals with running duties in view of instrumental reliability and technological coherence [23], [47], [73], [82], [94], [103], [111], [120].

Robotics is a non-revocable innovation, being qualified consumer of computer technology with, also, virtual-reality simulation as development aid, to support expert decision as on-process governing, and intelligent monitoring as recovery tool. The activity at the PMARLab, University of Genova, Italy, has been focusing on these ideas from the establishment over thirty years ago; the following research lines have been developed [28], [30], [31], [32], [33], [34], [35], [36]:

A) the design of duty-oriented facilities, with assigned functions/services;

B) the management of supply chains, having transparent eco-consistency;

C) the condition monitoring of biosphere depletion/contamination figures.

A few remarks are hereafter summarised.

The current industrialism stays confined in governmental regulations and market-law economics, as if the ‹natural capital› has limitless substitutes at local autonomy, defining self-contained fiscal affairs, macro-economics, national debt planning, etc., because, in the past, this proved to be winning policy. From now on, the ‹lifecycle inventory› will be reference to the ‹sustainable corporation› concept. The new supply chains combine material and information trails: the deliveries cannot be exchanged without their qualifying eco-figures. The transparency of behaviours and the visibility of impending threats could help to orient the changes. The ecology makes everyone aware of the bounded availability of the Earth's stocks and of the limited reclamation abilities by inherent courses. The trends show that a lasting pro-capita natural capital is a critical prospect, if a planned safeguarding is delayed; this is perhaps not directly perceived as personal injury, but it justifies only if we reject inter-generation imperatives of fairness. A sustainability or bounded decay goal requires imposing given clear-cut thresholds, measuring them and assuring fallout monitoring and sanctions. The eco-consistent re-engineering of the industrial activity is a methodical option pre-qualified by design/management aids:

- a metrics specification, with eco-efficiency indices and eco-fee allocations;
- an ecology supply chain organisation, targeted at product-service delivering;
- a registration scheme, for including/deleting the ‹sustainable corporations›;
- an ecology re-engineering system, aimed at social/economic/political goals.

The legal specification and official monitoring/certification of the eco-data are necessary prerequisites. In view of both aims, the scientific specialisation and the civic consciousness are worth help. It will be a XXI century challenging adventure. By now: forewarned, forearmed; the idea is to give visibility on the on-going decay and transparency of the individual and communal behaviours.

II. THE DESIGN OF ROBOT-AGE INFRASTRUCTURES

The producer's responsibility of the delivered supply chains is epochal changeover today and not fully understood by most of the entrepreneurial businesses. In the present survey, the engineering standpoints are the only focus, leaving out the financial, economic and political facets, since the attention was limited on the characteristics of the desirable new technical implements organised around the *lifecycle conformance certification* (LCC) requisites. The equipment to be brought out in the market are increasingly complex and need an information flow to go parallel to the material processes, in order to provide the on-the-go accounting of the eco-compatibility ranges of the delivery. It will the ‹robot-age›: computer advances expand rig capability and effectiveness; standards and modules upturn efficient outcomes, making intelligent automation affordable and reliable for wider number of jobs. Success critically depends on acknowledging behaviour and task progression with continuity. The choice is complex business, asking trials and checking sequences, which profit of computer-simulation for quantitative description of the alternatives. The implements already have extended acknowledgments [07], [13], [20], [55], [63], [86], [90], [115].

The design procedures have to deal with structural elements, function allocation, control strategies and information frames. Purposefully conceived CAD programmes are used to solve the single cases, to provide the *a priori* knowledge of different engagement situations, with prospects of command steering modulation, functional redundancy exploring, and impact analyses. The design phase profitably avails of modular blocks, aiming at the parallel investigation of fit alternatives. The availability of expert simulation backed by suitably tailored data-bases helps to re-design tasks and fixtures, anticipating actual performance and acknowledging return on investment, when innovative and sophisticated options are devised [09], [17], [39], [69], [76], [81], [89], [112].

The solution effectiveness largely depends on empirical figures and on previous results; expertise and know-how are profitably stored into databases, with heuristically driven decision support. The equipment operational bent pushes to a simultaneous design of products, processes, facilities, instrumentation, etc.; moreover, the actual engagements need apt trimming, through dynamics shaping, task planning, function adapting and so forth. Integrated design requires resorting to sophisticated aids to assure high operation performance, together with flexible interfacing options, to aim at suitably on-process upgrade [04], [18], [45], [59], [75], [87], [98], [110]. The information backing of the robot-age facilities supplies multiple-task steering, by unified programming aids, to link local controllers and input-output interfaces via a data-communication network. The end issues distinguish as for process and task properties, either: • assuring alternative functions; • paralleling separate actions; • interacting to face complexity. The versatility supports flexibility to avoid set-apart resources, still undertaking diversified situations in terms of tasks or recovery actions; the parallel operation improves productivity by functional specialisation or additive deployment; the cooperation extends versatility and dexterity.

The manufacturers' responsibility establishes a series of constraints on track increasing the ‹product data› to add, after the ‹process data› (by simultaneous engineering), the ‹enterprise data› (to help facility/function integration for lifecycle delivery), and the ‹environment data› (to comply the eco-regulation targets, according to the extant LCC requisites). The conservative portrayal of the resulting databases distinguishes:

- the PLM, product lifecycle manager, for the inclusive product-service specifications;
- the SE, service engineering, and RL, reverse logistics, for the oriented requirements.

Once all the facilities and functions are present, the ‹extended corporation› is fully empowered to operate with the *legal* eco-consistence and lawfulness. The ‹virtual corporation› substitute is worthy way to assemble the right facilities and functions, by temporary alliances, having a view on instant leanness. The ‹sustainable corporation› is a *legal* entity, today specified in relation to extant local government rules, complying standard *streamlined lifecycle assessment*, SLA, requirements. It might organise as an ‹extended› or a ‹virtual› enterprise, with long term obligations, as the delivery is supposed to last for a while, after which the end-of-life undertakings ought to be totally done. Hence, the ‹sustainable corporation› shall include the following traits:

- legal personality: the purveyors act as single unit, in relation to all the involved people;
- responsiveness: the acting unit engages jointly and severally the involved partnership;
- global liability: the delivery assures close-to-market clearness (e.g. for free take-back);
- eco-transparency: the contractors manage PLM, SE and RL data, granting full visibility;
- accredited quality: the supply overseen is entrusted to third-party certification bodies.

The ‹sustainable corporation›, if built as a cooperation partnership concerned by the business project opportunity, is forced to reject an ephemeral alliance, at odds with a lifecycle/end-of-life liability. Authorised remedies are insurance partners, deposit/refund schemas, charge reversal contracts, etc. meeting the delivery charges with automatic measures. The agreement standardisation helps detailing the essential schemes of the manufacturers' lifecycle liability, checked by accredited bodies (below again detailed). The impartial certification has a twin aim:

- to attest the correct compliance with the passed eco-regulation national targets;
- to endorse the conformity ranges, in relation to existing inter-state agreements.

The certification bodies are independent players, offering, in competition, qualified services. In these initial views, their status needs a twofold amenability:

- to be accredited with the national authorities, as for capability and skill;
- to be notified, through inter-state agencies, achieving worldwide fitness.

Owing to ecology globalisation, the proficient certification system shall reach the twofold coherence. The individual body operates due to attained expertise, feasibly, acknowledged by a series of stimulated ‹settlement councils›, which integrate the accreditation/notification acquiescence, with no need to resort to official governmental authority, because totally supported through bottom-up ‹big society› procedures. Indeed, the producer's liability is technical engagement, resorting to qualified capabilities and assessed outcomes. The ‹sustainable corporation› is in-between accomplishment towards eco-consistent demeanours: the basic goals are specified and enacted matching fit technical-scientific expertise; the manufacturer's responsibility identifies the correct product-service procedures, lastly monitored and verified by ad-hoc professionals.

III. THE INTEGRATION OF SERVICING AND MAINTENANCE

The manufacture, traditionally, look at the ‹point of sale›, leaving out the items' lifecycle/end-of-life, as if the whole related duties can be totally disregarded by the business project. The transformation value-added stops at this point; the resources' depletion and biosphere's corruption were ‹somebody› else burden, until when the ecology globalisation has made evident that the liable ‹consumers› comprise ‹manufacturers›, who take profit by the sold items, and ‹users›, who enjoy the durables/utilities, not to pour decay and pollution to totally non-guilty third people. The producer's responsibility means putting in charge of the industrial part of the ‹consumer's› twosome, the entire engineering tasks; the costs have to be, of course, repaid by the users, relieving the third people by damages and risks. It brings forth inventing the ‹extended corporation›, namely an entrepreneurial partnership, which combines the facilities for the lifecycle/end-of-life servicing, in coherence with the enacted eco-regulations. The partnership can be organised on the individual business project, bringing to ‹virtual corporation› instances, quickly updated, when the market raises different demands [06], [10], [22], [41], [44], [52], [99], [107].

Changes aim at ‹integrated› developments, to obtain deliveries, which incorporate diversified technologies, in order to make possible the transfer of the mix of properties, exactly matching the oriented requests of any particular buyer, in actual operation conditions. This means moving out of the conventional manufacture cycle, to include the provision of maintenance and restoring, to correct running conditions. The extension of competencies requires adding versatility to the entrepreneurial partnership, with service facilities, running jointly with the manufacture ones, and sharing data-bases and reference expertise. The ability to assess the profitability of a business is a must for its survival; quite happily this is a side effect of advanced information systems, characterising the ‹intelligent› factories, once the transparency of every transformation is established and the evaluation set up is actually enabled and understood. The option is grounded on monitoring the value cycle, transferred by manufacturing and servicing to the final deliveries. The resulting issues are, today, standard options [01], [12], [43], [48], [56], [78], [95], [105].

The producers' proficiency integration can be stated moving through the establishment of cognitive scales, obtained (according to the representational theory of measurements) by building factual standards, e.g., via a patterned interview method. The responsibility, moved from the ‹point of sale›, to lifecycle/end-of-life servicing and maintenance, ought to develop these interpersonal assessment options, linking technical and marketing staff, to purchasers and checkers by the use of suited understanding [11], [37], [42], [51], [61], [84], [101], [117]. The facility integration entails task allotment in unified environments. The govern modules enable decentralised or hierarchic policies: a controller adapts actions to the on-going job-progression; a scheduler activates tasks parallelism, once verified the programmed sequencing. The supply chain avails of information backing through ambient intelligence procedures. Value-cycle consistency is purposely enabled and assessed through emulation/simulation packages all along the life-cycle of the robotic facilities, with account of actually achievable goals as for performance and reliability.

The ‹extended corporation› assures product-process integral delivery, to qualify the supply chain with all the *legally* compulsory demands. The effective sustainability requires the control on four knowledge arenas, previously included by the PLM, SE and RL databases:

- product data: design, running, etc. files, lifecycle, maintenance, take-back, etc. files;
- process data: materials, manufacture, assembly, etc. files, service, recovery, etc. files;
- enterprise data: business (finance, trade, etc.), operation (management, etc.) functions;
- environment data: lifelong eco-specifications, end-of-life recovery/reclamation targets.

The whole has to be collected as coherent *product-process-enterprise-environment*, **2P2E**, picture, which organises the different scopes into unique business operation, incorporating the information flows of the four databases, into effective net-concerns, built merging two engineering options:

- simultaneous engineering: merging design and manufacturing for scope economy aims;
- firm-building planning: merging business and productivity with eco-conformance goals.

The overall entrepreneurial lay-out avails of computer engineering, for on-purpose deployment and performance assessment, by modelling and simulation procedures. The incorporation of facility/function architectures has to join the appropriate choices in view of the business project scheduling, with effective lawfulness managing of across-the-board duties and accomplishment burdens. The ‹extended enterprise› is a fresh option, related to network theory innovation, specialising fitting ‹net concerns›, to include the novel lifelong/end-of-life mandatory tasks. The basic steps of the development show that the fundamental technologies are available. Imaginably, the legal structures can follow diverse ways, comprising ‹virtual› substitutes, with timely facility/function choices. The cutting-edge improvements move from the ‹net concerns›. The concern managers, overseen by the certification bodies and aided by focused brokers, negotiate the configuration/reconfiguration of the productive lay-out, with the apt facility/function insertion, so that the instant assembly timely assures the optimal product-service delivery. In the backdrop, the knowledge domains and pertinent operation instances are crucial references to carry on the business idea, by the most appropriate technical choices and lawfulness management settings.

The **2P2E** integration permits the amalgamation of competences, totally heterogeneous, if considering the traditional manufacture internalities. The perfected externalities add crucial utilities and roles, to enable fit ecology and economy answerability, by eco-sustainable monitored and certified supply chains. Currently, the procedure considers ‹functional models›, and lists data and specifications necessary to the productive organisation, once the compulsory eco-regulation exists. The assembly of coherent solutions gives each time new ‹virtual corporation›; the delivery of complex products-services sees a set of facility/function changes, timely necessary to the productive organisation. The **2P2E** incorporation is an innovative prospect, requiring sophisticated modelling/simulation aids and multi-scale databases, with:

- unifying ontology taxonomies, with people-to-document and people-to-people codes;
- focus on the delivery sustainability profile, with widespread technical failure figures;
- cumulative account to manage complexity, with diagnose and recuperation purposes;
- special purpose portrayal, to take care of in-progress defined/enacted eco-regulations.

The example aids list basic themes of design engineering (first two) and applied planning (following two), directly related to data management and feature sharing mechanisms. The theoretical backdrops establish a self-comprehensive corporation portrayal, to make lifecycle assessment manageable. The practical operations aim at showing that the net-concern technologies are valuable way for answering to the ecology globalisation demands.

IV. THE ACCREDITED MONITORING AND CONTROL

The ‹consumer’s› twosome interacts with the civil society, namely, *extant* and *future* inhabitants of the biosphere. In fact, the yet-to-be citizens are passive followers in our world, with good points and drawbacks that we have instantiated. In the past, the ‹progress› tells that expanded know-how and better life-quality is enjoyed by the new generation; by the industrialism, depletion and effluence affect the earth, for amounts bigger than the natural recovery rate. Our riches are built, stealing the resources of other people (notably, the ones to-come) and with added contamination snags.

The lawful behaviour imposes respecting apt collective bylaws, enacted for unbiased life in common, markedly, in view of avoiding harms and troubles, with permanent damage of the shared surroundings. The earth downgrading due to the life forms is consequence of the *entropy* principle: the *life* creates local orders, moving decay apart; for *lawfulness*, the *intelligence* needs trend appraisal, assuring condition monitoring and control, within safe targets. The eco-regulation is categorical imperative, made necessary by the ecology globalisation: the rule uniformity ought to impose worldwide technically mandatory aims [02], [29], [40], [67], [77], [92], [100], [106].

The technical objectives are programmed through the producer’s responsibility, implying that, to bring out a new product, the manufacturer is required documenting the eco-footprint of the delivery, including full lifecycle assessment plus end-of-life remediation/recovery liability. The entrepreneurial business will evolve, engaging apposite ‹sustainable organisations›, namely, ‹extended enterprises›, which guarantee their supply chains, according to the enacted standards. The monitoring and overseeing is entrusted by third-party ‹accredited bodies›, which verify the on-progress lawfulness and certify the eco-consistency [25], [50], [62], [72], [74], [96], [114], [119].

The ecology globalisation demands totally revising the extant socio-political infrastructures. The here outlined clues propose resorting to bottom-up lines of action, grounded on *private* ‹sustainable organisations› and ‹accredited bodies›, which operate according to civic mindedness, because the interest of the humanity requires programming a safe steady future. The business projects, of course, have to be run in the extant ‹nation-states›. The delineated solution presumes that the eco-regulation has to be ruled according to subsidiarity precepts, with transnational agreements and under cross-border authorities. The ‹accredited bodies› need to be notified to the single governments; yet, the technical targets will stay exactly the same all over the *global village*. The upshots to be assessed and controlled are in the domain of merely technical decisions [15], [52], [60], [66], [71], [80], [91], [113].

In view of functional schedules, multi-task actors select the right govern architecture, say: • hierarchic information tree-structure (the cooperation centrally is managed under explicitly established supervisor); • distributed information cluster (the actors, interfaced by an intelligent layer, share common interest data and shape cooperation by decentralised control). From merely technical standpoints, the coherent eco-design moves from ‹lifecycle inventory› with the apt *product lifecycle assessment*, PLA. The procedure entails combined tools, currently described by changeful knowledge frames, progressively modified, when the eco-consciousness increases, still, basically resorting to standardised computer aids, depending on specialised tasks, i.e.:

- competing product-service choice, by *streamlined lifecycle assessment*, SLA, tools;
- product-service delivery, trimmed by *computer aided lifecycle inventory*, CALI, aids;
- lifelong monitoring, diagnoses and evaluations, done by PLM, SE and RL databases;
- setting of *accredited/notified certification*, ANC, bodies for supply chain lawfulness.

The preliminary duty starts with the ‹streamlined lifecycle assessment›, SLA, using a standard evaluation, capable of interfacing the ‹product lifecycle assessment›, PLA, requirements with the full PLM, SE and RL databases. A major goal is to detail the ‹computer aided lifecycle inventory›, CALI, file, to perform the product-service delivery, linking scope issue and impact appraisal. The standardised inventory aims at linking lifelong servicing and supply chain specification. So: the SE is qualifying provision of innovative producers; the RL is mandatory request in some cases (in EU, in the ELV, end-of-life vehicle, WEEE, waste electrical-electronic equipment, etc.). The PLM, SE and RL databases are supposed to widen, covering all the mass-produced goods. Today, the coherent eco-design is far from efficient; the three SLA-CALI-PLM/SE/RL-steps progress, mostly as academic proposals. In addition, the certification bodies, basically, interact with the purchasers; the manufacturers provide product data (rather than PLM/SE/RL-databases); the PLA tools, in SLA version are suggestions, aiming at ‹sustainable corporation› standardisation; the CALI aids are implemented as proprietary options. The inclusive embryonic stage is serious hindrance.

Anyhow, the listed computer tools are deemed to transform the traditional ‹service› externalities in some standard facility/function options, adding as specialised infrastructures in the manufacture business to come. The brand-new changes classify at different ranges. The earlier enterprises qualify their know-how, from the former CAD and CAM design developments, to the upgraded SLA-CALI-PLM/SE/RL-service competences. The computer-aided domain includes, also, more focused tools, such as the ones allowing to manage the product adaptive changing; moreover, for the ‹virtual enterprise›, tools for fittingly specialising the ‹net concerns› are essential supplements. The ‹change› process is driven by interactively looking at the lifecycle data, merging the outer stimuli with the on-going appraisals. The adaptive flow of the products through the plant is known scope-economy good point of the robot technologies; the adaptive flow of the facilities/functions through the production is innovative opportunity of the network theory. The ‹change› motivation along the industrialism is permanently supported by ‹technical capital› advances; until now, it goes through, mainly, ‹human capital› imperatives, to settle the class struggle against earlier moguls, ‹financial capital› centred. From now on, the ‹natural capital› turns into impending threat. Looking a bit more at details, the ‹change› drivers can classify as: technological (innovation breaks), environmental (waste reliefs), political (collective orders), economic (trade measures), financial (market protocols), social (welfare rules), and so forth. The enterprise’s reactivity allows aligning the offer to the (unpredictable) variations. The ‹product› upgrading is engineering rehearsal; the ‹product-service› is convenient supplementary choice, if the today externalities become integrated aids, adding to the conformist manufacturing internalities, to bring forth ‹extended corporations›. The ‹enterprise› upgrading is engineering practice to come, applying the ‹firm theory› principles, to support the adaptive re-shaping of the facility/function lay-out.

The list of computer tools enters the accredited/notified certification, ANC, files, to help specifying the necessary third-party bodies, overseeing the ‹sustainable corporations› and allocating fit lawfulness to their activity. This development, also, belongs to the academic proposals, with marginal impact on the everyday life. If looking at the parallels among PLA and SLA files, the existing ANC aids are simplified drafts, basically, ranging at two levels: rationalised schemas, issued by international standardisation agencies (ISO, etc.) with an aim at universal levels; streamlined directives, delivered by official governmental/international agencies, specifying the completions, to be fulfilled by the certification bodies. The ‹certification› is carried over by independent technical agents, which are thought to operate, in competition, on the market, offering a skilled service, based on their qualification. The ‹certification› business is supposed replacing the standard ‹control› operations performed by the governmental authorities, to lower the bureaucratic charges, by the effectiveness of lean and flexible specialisation. Until now, the ‹certification› is understood to be accomplished with power of proxy, in lieu of the official ‹control›, as the ‹authority› identifies in the ‹nation-state›. The ecology raises further questions, if the outlined ‹nation-and-company› field partition becomes defective.

V. CONCLUSIONS

The ‹sustainable corporation› concept is trustworthy way, to enable eco-consistent supply chains, wholly managed by front-end technical apparatuses. The present outlook considers the design and management aids, which purposely are requested to enable the knowledge infrastructures, supporting the changeover. At the backdrop, basically, the engineer has to deal with totally the new demands of the lifecycle eco-characterisation of the deliveries, including the annexed maintenance, recycling, recovery and remediation duties. The paradigm updating opens numerous and contradictory queries, all in all, hardly defined [19], [26], [38], [57], [65], [83], [102], [108].

The relevant outcome addresses the ‹extended corporation› settings, directly or through properly-adapted ‹virtual corporation› instances, to collect facilities and functions, which join intelligent manufacturing and servicing, up to the needed versatility. The entrepreneurial partnership supplies: job-driven meanings, with joint-operation to improve the dexterity/versatility figures; execution performance, with tasks constraints, including the expected accuracy/efficiency figures; information set-up and govern environment, with indication of the selected observation/control architectures; at the business project range [08], [21], [49], [53], [64], [88], [104], [118]. Efficiency depends on the ability of exploiting versatility. The joint-operation skills are trimmed by the on-process *intelligence*, provided by the information backdrop and the befittingly enabled learning processes. During the operation lifecycle, simulation packages, suitably fitted with govern emulation blocks, generate forecasts and feasibility studies of alternative schedules [05], [14], [16], [27], [54], [70], [85], [93].

The *streamlined lifecycle assessment*, SLA, standards and tied *lifecycle conformance certification*, LCC, specifications are mandatory tools, to fulfil the manufacturer’s design and management of the eco-consistent product-service delivery. The supply chain renewing ensues the producer’s lifecycle obligations; the SLA accreditation is qualifying label; the LCC issues permit proving the appeal of the related choices, once their profitability is shown (or their unavailability is really punished). Thereafter, the supply chain of products-services is necessary start, exploited once the tied information flows fully describe the eco-footprint of the material (direct and connected) flows. The accounts have, accordingly, to include:

- the delivery eco-footprint, with the compulsory recovery/reclamation targets;
- the corporate social duties, engaging ownership, employees and stakeholders.

Summing up, for corporate’s lawfulness, the delivered products-services shall comply the SLA standards and LCC classifications. The voluntary role and improvement effort are options, suitably managed also within a ‹big society› setting, based on third-party ‹accredited bodies›. The cleaner environment is successful achievement of a communal accountability, no mind which ‹political order› is addressed. The query arises: why do enterprises engage is a business, at first view, economically illogical? The answer is forced to consider longer terms outcomes, dropping instant gains. The enterprise’s profits do not establish at the point-of-sale, as the ‹consumers› (manufacturers plus purchasers) shall embrace the eco-fees for recovery/reclamation and third people losses. The selfish conduct is banned, and the lifecycle costs ought to be carefully minimised, if a producer plans to be competitive. The logical behaviour on the longer terms outcomes is, thus, exactly the one of the ‹sustainable corporation›. The protection of the biosphere is a global village necessity, entailing the yet-to-be generations. The selfish utility of the current citizens cannot be matter of democratic consent, exerted by merely the extant voters.

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