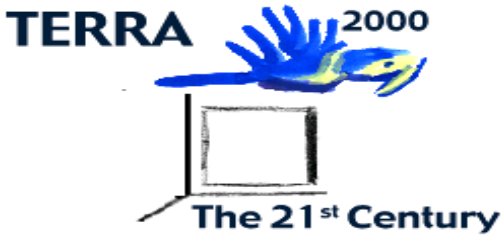

The Story of TERRA

Tools for supporting policy at the IS-SD interface so as to maximise the Information Society's benefit to humankind.

Edited by

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Foreword

The TERRA project is concerned with the creation of scenarios and models, of present and future developments, in order to support policy debate and decision making aimed at optimising the contribution of Information Society Technologies to Sustainable Development. For the purposes of TERRA it is taken as read that attaining Sustainable Development (as defined by e.g. the Brundtland Commission) is both desirable and something to which the Information Society and its associated technologies can contribute. The IS is, in part, already with us, so attaining sustainability necessitates an understanding of the implications of the IS and the potential for change it brings. The starting point for TERRA is thus a de facto 'IST proposition':

The new technologies of the Information Society (ISTs) seem likely to offer scope to enable economic growth, and to allow a more equitable distribution of wealth, without necessarily increasing consumption, pollution and energy use.

This is a proposition in need of both proof – in that many would deny it – and implementation – in that sustainable development within the IS requires active and adaptive employment of ISTs. To meet these requirements, TERRA decomposes the IST proposition itself into sub-propositions relating to specific domains – these form the first section of the Story of TERRA. Implementation of these propositions is a task for public policy as well as private action; the second section of the 'Story' therefore develops the progression from historic data (affording hindsight) through models and scenarios (whose main purpose is shedding light on the inner workings of the IS-SD interface, i.e. providing insight) to their contribution to the necessary background for the creation of public policy (which necessitates some complementary foresight).

The third section of the Story of TERRA surveys the conceptual frameworks available, divided into chronologically and effectively distinct phases with typical accompanying 'rebound' effects. Such conceptual frameworks help interpretation of specific data; but these data must exist, be gathered and collated, and ultimately be handled by suitable analysis tools. The fourth section describes these data sources (UN; OECD; World Values Survey etc), analytical tools (ASA, IFS) and the scenario framework.

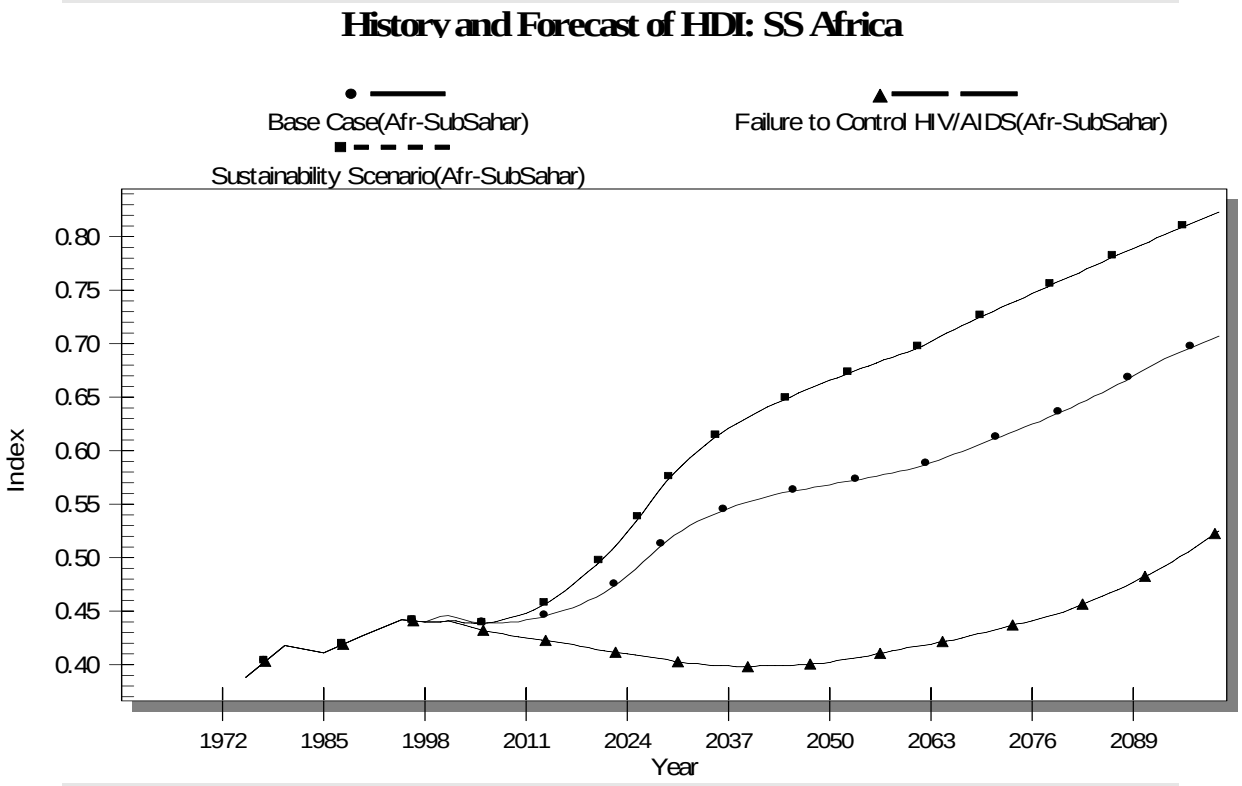
The next two sections illustrate the work of the project in developing, respectively, specific policy perspectives relating to human and social development) and to environmental and ecological considerations. The final section considers a number of topics highlighted by TERRA relating to an even more uncertain future in which change is discontinuous or radical, or where more work is needed – for instance where data or indicators are missing; where theory is inadequately developed; and/or where policy issues have received insufficient attention.

This document is the 'Story of TERRA': all of the additional material shown in the diagram is available from the TERRA web site www.terra-2000.org

TERRA in Action – an Example of Advice for a U.N. Agency

Forecasting the Human Development Index

The 'Human Development Report office' of the UNDP use the Human development Index (HDI) as a measure for summarising the state of development in the world's 164 nations, and for portraying the dynamics of development. Although some mid-term predictions have been made for HDI on a single country basis, the forecasting of HDI for all nations in the longer term had not previously been attempted. Using, inter alia, the TERRA sustainability scenarios enabled a range of forecasts: those shown below for sub-Saharan Africa are respectively the base case; the 'failure-to-control-HIV' case; and the TERRA sustainability case, showing, in each case, the trajectory of movement of the HDI over a period of 30 years in the past and 100 years into the future.



These figures, produced within the IFs for TERRA modeling framework, can of course be presented in many different formats and styles, including the simple spreadsheet below.

SS African HDI	1980	1990	2000	2010	2020	2030	2040	2050
Base	0.418	0.427	0.445	0.44	0.463	0.521	0.553	0.568
HIV Failure	0.418	0.427	0.44	0.426	0.414	0.403	0.398	0.402
Sustainability	0.418	0.427	0.44	0.446	0.493	0.579	0.633	0.666

The IST proposition and its sectoral sub-propositions

1. ISTs and Sustainable Development

TERRA provides the means to test the fundamental 'IST proposition' and its sectoral sub-propositions, and offers guidance on how the vision they embody may be made a reality.

1.1. The IST Proposition

The new technologies of the Information Society (ISTs) seem likely to offer scope to enable economic growth, and to allow a more equitable distribution of wealth, without necessarily increasing consumption, pollution and energy use.

2. Economic Sustainability and Human capital in the Information Age

Skilled, talented, innovative and fulfilled people constitute human capital, which fuels economic growth. All people everywhere have the potential to contribute. One major policy dilemma already facing decision makers is how to secure the supply of human capital with the declining and aging population.

2.1. Economic sustainability propositions

- *ISTs can catalyse human capital expansion and thus promote sustainable economic growth*
- *Expansion of the GNKS can sustain and diffuse increases in productivity and market efficiency throughout the globalised economic system.*

3. Social Sustainability, Equity, and Growth

"Social capital is the glue that holds a society together." A major dilemma for the 21st century will be how to balance the economic growth needed to reduce unemployment with the reduction of inequality needed to secure social capital.

3.1. Social sustainability propositions

- *While initial deployments of ISTs and 'New Economy' dynamics have tended to exacerbate welfare, digital and/or income 'divides,' the unfolding of a GNKS based on open and universal access can harness the same technological, market and social forces to promote greater equality of opportunity compared either to recent experience or the pre-GNKS era.*
- *The GNKS encourages and influences the processes of globalisation and can foster collective awareness of collective problems, mobilise local responses and promote emergence of new governance institutions to balance local and global problems, incentives and powers to act.*
- *While the mere fact of globalisation – the connection of each to all – does not of itself imply either integration or convergence, ISTs can facilitate mutual awareness and respect.*
- *The GNKS can encourage peace and minimise conflict by substituting a complex interlocking maze of global allegiances for previously narrow tribal and racial allegiances.*

The IST proposition and its sectoral sub-propositions

4. Environmental Sustainability in the Information Age

On one hand, ISTs bring a burgeoning middle class, increasing consumption loads; on the other, they allow more efficient extraction, accelerating exhaustion and delaying development of substitutes. Rebounds and secondary and tertiary effects are already well understood in some circumstances – but by no means all. Policy issues include informational approaches to enhancing efficiency of resource use, corrective taxation, support for development of alternatives, etc.

4.1. Environmental sustainability propositions

- *Emergent technologies based on information (from ICTs to bioengineering) can dematerialise production and distribution of goods and services by reducing associated material inputs and waste outputs.*
- *The new technologies and the new forms of human interaction they support can lead to substitution of immaterial goods and services for material production and consumption.*
- *Dematerialisation and immaterialisation reduce the opportunity cost (price) of material inputs and environmental sinks and increase the welfare content of income and wealth. The relative price changes can induce substitution of material for immaterial inputs. Increased purchasing power can stimulate consumption of both material and immaterial goods and services. These substitution and income effects can outweigh the benefits of the original changes.*

5. Distributional Impact

The distribution of access to inputs (including human capital) can provide a better explanation of growth and convergence than total or average input levels; the welfare implications of inequality are strongly affected by the reference groups considered by people around the world – and thus by those portions of the global distribution in the IS spotlight; and environmental sustainability and resilience depend on the spatial and temporal dispersion of economic resource exploitation and discharges. Conversely, the impacts of economic, societal and ecological development on these important distributions can only be understood if the mechanisms of dispersion and differentiation are included in the analysis.

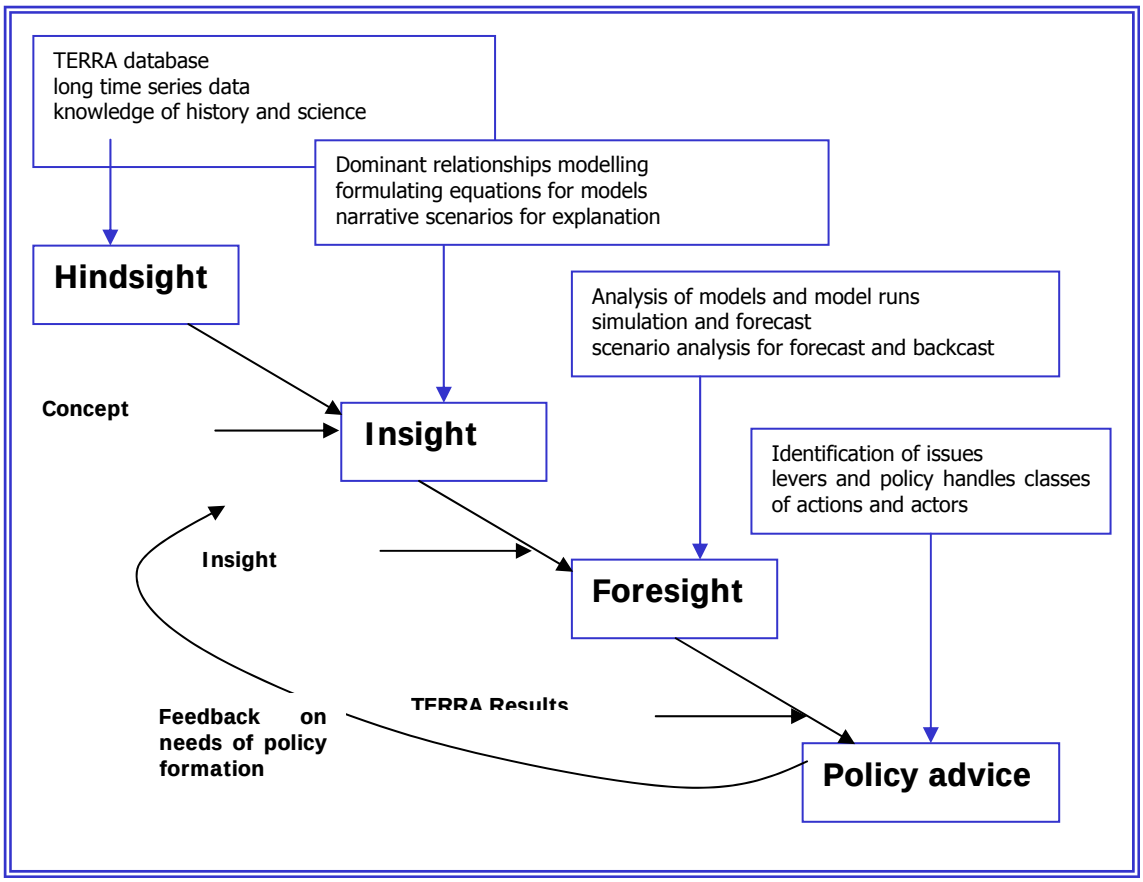
5.1. The distributional proposition

- *Distributions (e.g. inequalities) matter at least as much as aggregates because: i) welfare and incentives are relative; ii) globalisation and the network economy hold out the promise of greater equity while increasing the likelihood that laissez-faire policy will exacerbate divides; iii) different parts of distributions have potentially divergent values and sustainability footprints and responses to policy and economic/political, etc. forces; and iv) network evolution can lead to small worlds, stable diversity, global convergence, etc. with only minor changes in the underlying parameters.*

Support for Policy Making – the TERRA 'Backbone' Task

Underlying the TERRA work of expanding and testing the 'IST Proposition' and optimising ISTs' contribution to sustainability is a progressive development of understanding from the insight to policy creation.

TERRA is much concerned with modelling and with the use of scenarios, but is not tied to any single paradigm of modelling or of scenario formulation. The TERRA backbone runs from established data and knowledge, through the creation of insight via suitable established formal model/scenario techniques to the enabling of foresight. Policy advice derives from foresight mediated by insight. Insight thus lies at the heart of TERRA. The models in TERRA are made in a transparent way – they are not intended to be 'black boxes' whose workings may only be understood by the initiated, producing definitive forecasts and prescriptions, but consist rather of visible structures of explained linkages whose workings can be examined and discussed as a means of coming to greater understanding. It is through the visibility and quality of the reasoning that policy advice in TERRA is given substance and made trustworthy: ultimately, the purpose of TERRA is that its advice should be accepted and acted on.



The relationship between the Information Society Technologies (ISTs) themselves, and their wider societal impact in the shape of the Information Society and/or New Economy is being elaborated by TERRA's linked series of

Narrative scenarios and numerical models concentrating on identifying and expanding the most crucial aspects of the picture. This Dominant Relationships Modelling preserves scientific integrity (by modelling only that which may reasonably be measured or formalised and thus modelled). This is combined with a high degree of transparency (since policy recommendations will not normally be accepted, fruitfully debated or usefully acted on if they cannot be confidently understood by those to whom they are directed).

Support for Policy Making – TERRA results

In addition to the scenarios and models that support policy briefing, some background material is also required. Concept Sheets operate at the widest level, describing and explaining concepts that are common to the whole generality of IST's impact on S.D. (and so belong at the level of hindsight – indeed much of the material in them long predate TERRA). Topics covered by TERRA Concept Sheets are:

1	What is Sustainability?
2	The Relationship of the Information Age to Sustainability
3	Globalisation and the Network Society
4	Lifestyle, ISTs and Sustainability
5	Rebound Effects in the IST Context
6	Integration and Interconnection in TERRA
7	Resilience
8	Poverty and Equity
9	Human Capital

Insight Primers operate more narrowly, describing and explaining mechanisms rather than concepts, and thus being entirely in the 'here and now', the area we call insight. Topics covered by TERRA Insight Primers are:

1	ISTs and reducing environmental impacts
2	ISTs and reducing inequality
3	ISTs and increasing human ability and potential
4	ISTs and 'weak signals' of coming change

These supporting documents are available on www.terra-2000.org.

A Note on Data, Models and Scenarios in TERRA

The development of TERRA takes place on several levels, characterised in what follows as hindsight, insight and foresight. Hindsight is based on databases and statistical analyses, Insight is based on models and scenarios designed to describe the functioning of underlying mechanisms and their linkages, and Foresight is based on the use of such mechanisms to support projections of the future evolution of systems (observed by data and indicators) and the impact on systems of the use of policy levers under different circumstances.

Understanding the evolution of complex systems requires a combination of data, models and scenarios. *Models* and *Scenarios* help us understand what the *Data* do and do not tell us, and unlock information hidden in them. The term data typically refers to quantitative measures, but the underlying variables can be 'hard' (naturally quantified, objectively measurable) or 'soft' (only measured through indicators and/or subjectively defined).

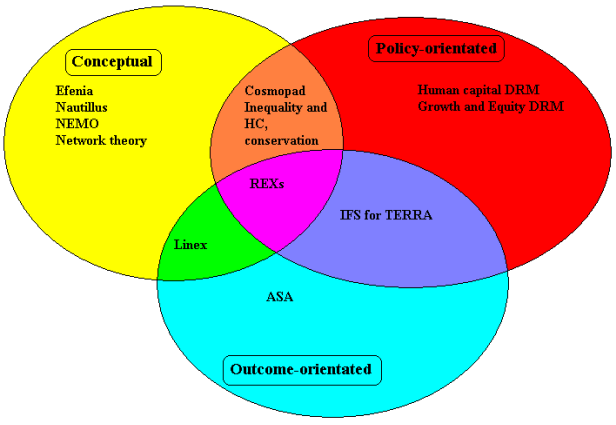
When considering the future unfolding of the Information Age, it is useful to distinguish three types of scenarios and models used for projection, for policy simulation and for policy analysis. The first (often called business-as-usual) is generally mere trend extrapolation and so gives primacy to the data. The second incorporates policy levers into the structure to facilitate 'what-if' exploration of alternative policies. The third exposes the mechanism's underlying observed behaviour to logical scrutiny. All depend primarily on understanding of the past and of the present rather than of the future, but all offer formalised methods of discussing possible futures, the prime purpose of TERRA.

Models Produced in TERRA

Models help to unlock latent tendencies in data, test our understanding of system structure and dynamics, and discuss policy issues in ways that expose assumptions and rules of inference. Models can use and/or generate data, but not all models do so. As used here, the term model refers to a quantitative description of all or part of the TERRA system. Models can be classified by form: i) *computational* models of varying complexity, completeness and fidelity to empirical data; *empirical* models to test specific hypotheses against real data and develop predictions from proven hypotheses; and *theoretical* models to derive useful conclusions from a set of starting assumptions and rules of inference. More broadly, TERRA models fall into three functional categories.

Level	*Purpose*	*Horizontal Span*
Conceptual ("what should be")	Sheds light on complex ideas lacking structure, data, etc.; guide lower level modelling, generate rigorous/ qualitative insight relating to general principles.	Features of 'deep' structure common to all thematic domains (e.g. networking, globalisation, etc.)
Policy-orientated ("what could be")	To give (external) meaning in terms of mechanisms and levers	Policy domains: decision proc., ministries, levers, jurisdictions
Outcome-orientated ("what would be")	Quantify/illustrate spillovers, support signpost/trigger planning, gaming, illustrate for wider audiences.	Linkages across IS↔ sustainability domains

These types often overlap, as the following map of TERRA models shows:



An overview of TERRA's broad range of modelling activities is provided below. In TERRA, models were used all along the 'backbone' shown on page 5. For hindsight, the main integrated model (IFs for TERRA) and the related indicator-based sustainable development model (ASA) provide comprehensive tools for exploring the past and the *status quo*. Of course, the empirical models, being estimated using historical data, provide summaries of past outcome and trends.

From Hindsight to Foresight via Insight

Model	*Type*	*Focus*
Conceptual System Dynamics Model of Planetary Agricultural & Biomass Development (COSMOPAD)	Computational - Insight	Human-induced worldwide biomass production and its effects
Effects on Environment of Internet Applications (EFENIA)	Computational - Insight	Environmental requirements of key elements of GNKS infrastructure for IT applications
Networking Effects Model (NEMO)	Computational - Insight	Examination of competing SD paradigms: constraints and technological potential
Dominant relations human and social capital model(s) (DRM)	Computational - Dominant relations	Foresight into power of immigration, education, and growth in labour productivity to overcome projected skill shortages and examination of social capital and equity development.
Advanced Sustainability Analysis (ASA)	Computational - Integrated	Crosscutting SD analysis based on 'master equations' relating welfare and environmental stress to indicators of economic, technological and social development.
Collective Modelling Platform	Computational - Integrated	Collecting and integrating systems dynamics models
IFs for TERRA (IFs)	Computational - Integrated	Large-scale integrated global modelling system adapted to GNKS features and policy levers. Serves data exploration and scenario development/analysis.
Resource Exergy Services (REXs)	Empirical - Integrated macro econometric forecasting model	New formulations of important components of economy-energy models: capital accumulation, resource use and technology-innovation
Linex macro production function	Empirical	Accounting for role of physical work in growth
Human capital inequality model	Empirical	Panel model of relationship of human capital inequality to growth.
Network structure, behaviour coevolution	Theoretical	Game-theoretic model of evolution of co-ordinated behaviour and network structure, used to analyse network aspect of SD
Inequality and conservation	Theoretical	Game-theoretic model of inequality and conservation of commons
Networking Activity Understanding and Testing Instrument Linking Logic reasoning and the Use of Simulation (NAUTILLUS)	Theoretical-computational	Simulation tool for examining growth and properties of random networks.

Models Produced in TERRA

Information on the TERRA models is available on www.terra-2000.org.

Scenarios Produced in TERRA

Scenarios provide a common basis for discussion and analysis, to ensure that progress towards understanding the strength and policy implications of the propositions is at the same time logically consistent, reasonably comprehensive, comprehensible and engaging for stakeholders, calibrated to real data where possible, appropriately sensitive to both hard and soft data and relevant to policy issues. They are thus a tool for exploring knowledge and improving coordination. TERRA scenarios are used in various ways. They are used as a framing device for describing the current situation, identifying trends and possible interventions, and making visible important criteria. This is particularly true of the Human Capital scenarios, in which the level of description is primarily numerical and based on explicit computations in order to provide a sense of the scope of the issues considered, quantify the direct and side effects of various specific policies and aid the search for attractive combinations of policies. The Equity and Growth scenarios are more explicitly laid out in 'scenario space' along two critical dimensions, but also make use of dominant relations computations to calibrate the 'storyline' and the powers of the actors. The Information Age Sustainability scenarios are described in terms of welfare and environmental stress dimensions, and scenarios developed along the lines of feasible trend extrapolation.

A scenario is a partial description of a set of possible futures based on a description of the *status quo ante*, a set of actors (with motivations, powers, and information), a system (with well-defined boundaries and mechanisms), and specific dimensions along which it is described or tracked. The narrative core of the scenario constitutes an implied storyline about future evolution, which may include branches and critical uncertainties. Scenarios should be described in concrete terms, be internally and logically consistent, and illustrate the major issues. As predictors of the future, their only common feature is that they are false in detail. As a result, multiple scenarios are preferable to single ones, and their construction is not only non-trivial, but may prove to be more important than the end result. Ultimately, therefore, they must be experienced interactively.

The inclusion in all scenarios of important factors whose values are known or can be predicted is important to ensure acceptance and relevance. Less important known factors can be included to make the scenario seem more concrete and relevant. The factors that are at the same time uncertain and important define the dimensions of 'scenario space' – they differentiate the scenarios from one another. Uncertain factors of minor or narrow importance are included to give colour and life to the scenario and to serve as the springboard for 'weak signal' analysis of developments whose likelihood and importance can be imagined but not assessed.

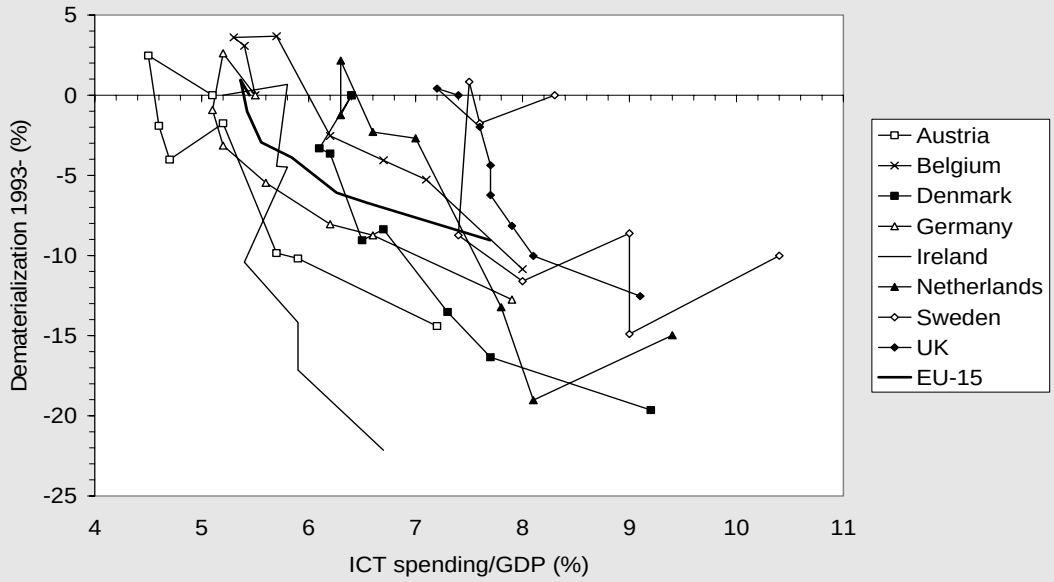
Scenario Frame	*Uncertainties*	*Policy levers*	*Mechanisms*	*Indicators*
Human Capital	Output, consumption growth, population	Investment, education, migration, outsourcing, labour productivity	Aggregate dominant relations focusing on global ICT sector, paradigmatic model of network economy.	Skill supply, demand, consumption, unemployment, population (size, migration), GNP growth, trade balance, social support.
Equity and Growth	Internalisation of ecological constraints, consensus/human-rights-based governance	Market mechanisms, co-financing, global contract, security measures, trade/aid requirements.	Dominant relations among prosperity, equity, human domination of the earth, 'Information Age'	Equity value, GNP growth, Global Hectare Equivalent, carrying capacities
Information Age Sustainability	Dematerialisation, rebound, economic growth	Factors affecting dematerialisation, immaterialisation, rebound effects, welfare productivity of GDP, IS development	Indicator models of interrelated economic, population and material intensity changes, Macroeconometric growth model, paradigmatic agriculture model	GDP, environmental stress, population; dematerialisation, immaterialisation, ASA-sustainability, energy use, land requirements
TERRA apocrypha	Separating weak signals from noise, emergence	Potentially, all.	Coevolution of network structure, flows, behaviour of networked entities; emergent behaviour, innovation	New indicators relating to network structure, efficiency, equity, resilience

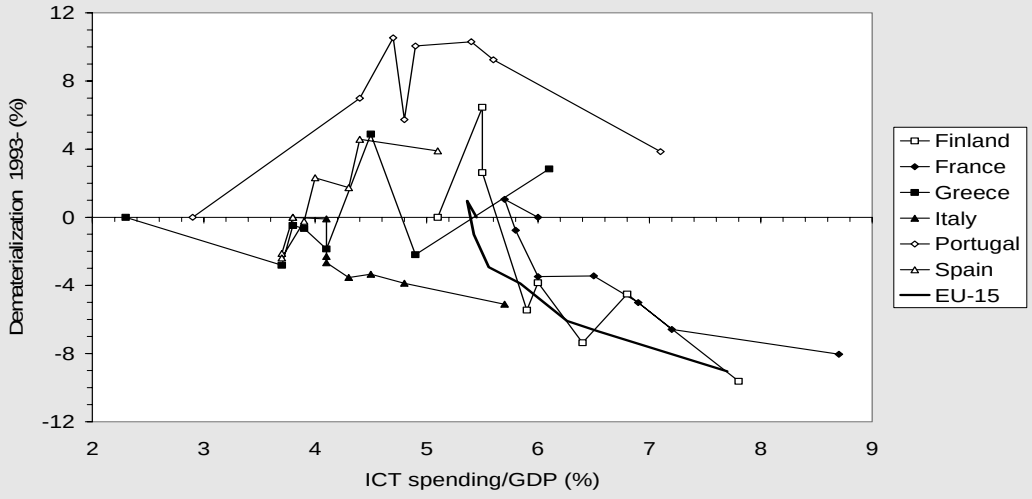
Scenarios produced in TERRA

The past is by far the best guide we have to the future, and many aspects of the future are indeed likely to be simple extensions of features we observe today. However, if we look back into the past as a guide, it is also observable that, at almost any moment in the last few hundred years, we have been on the verge of some change, or invention, or event that has changed the course of the future dramatically. We should expect, therefore, that the same is true today – something is on the horizon that will deflect the course of future events dramatically – but what? We can never know – but equally we can't ignore the possibility. This class of future consideration is definitively not susceptible to trend analysis, and poses considerable difficulties for scenario analysis. Its preferred tool for development in TERRA is thus 'Weak Signals Analysis', supplemented by analyses that relate to concepts (shock etc). Inevitably this class of discussion runs to some extent counter to the accepted wisdom of the day, but the intention of Weak Signals Analysis is not to be controversialist but to be illuminative.

TERRA in Action – Showing How ICTs Cut Material Consumption

The Finland Future Research centre were asked by the Finnish Government to advise on the relationship between spending on ICTs on the one hand, and reduction in material consumption on the other. Using the ASA tool developed in TERRA, it was possible to demonstrate that accelerating technological development does improve the eco-efficiency of production and is an important policy area. Correlation analyses of dependence between the dematerialization rate and ICT investments give reason to formulate a "5 % rule"- hypothesis: Strong dematerialization starts to take place after the ICT investment ratio exceeds five per cent of the GDP (as in e.g. Austria). Other countries have followed suit with a higher ratio of ICT spending; up to 8% .





The correlation between ICT spending and the cumulative dematerialization of material domestic extraction 1993-2000

TERRA in Action - Policy Briefing for the Unforeseen Unknown

Policy Briefing - An Example using Weak Signals

Description: There is an implicit link between GDP/capita; welfare; and consumption. These are rather loosely assumed to follow trajectories that are at least sub-parallel. However, many commentators assert that welfare has become de-coupled from GDP increases and is static or declining in many developed economies. That assertion can, however, be read as no more than a re-definition of welfare in non-monetary forms. Nonetheless, new data shows that some basic consumptions (e.g. energy) may cease to rise with GDP/capita after a certain point. Taken together, these two related possibilities might be taken to mean that there exists a level of GDP/capita (not necessarily fixed over time) that represents 'Welfare Saturation', beyond which neither welfare nor certain elements of consumption increase with increasing income.

Potential Implications: The existence of a concept of welfare saturation would introduce a number of consequent changes in perception in different domains:

- Economic At the point of saturation, the rational buying behaviour of *homo economicus* would apparently change – but to what? Behaviour seems to derive from values and beliefs – so what changes here? The aspiration element in motivation must somehow be affected – but how? And what new buying patterns replace the old? Does this accentuate (or even in part account for) the shift from goods to services?
- Sociological Money may never have bought happiness, but nonetheless the fallacy seemed to work for many people. If happiness levels peak and then either remain static or fall, does life become a certain route to disappointment? Is the prospect of some sort of 'betterment' a necessary part of the condition of man (as in 'life, liberty, and the pursuit of happiness') or is stasis a comfortable state (as in 'liberte, fraternite, egalite')?
- Environmental If there is an upper bound to the consumption of energy per capita, then there is an implied upper bound to e.g. the creation of pollution. This is superficially a good thing; but then will that upper bound become, in its turn, the accepted norm when developed nations negotiate on emissions? And what (presumably immaterial, or at least less material) consumptions will occur post-saturation? The Rebound from immaterialisation is an income effect, so a multiplier on the original situation of excess income. Does the excess income become meaningful investment? Or support more but different pollution?
- Cultural Anecdotally, interest in eastern, non-material, belief systems is on the increase in developed nations. Do cultural alternatives relate to welfare saturation and post-materialism? Hardt and Negri postulate an introverted, post-material dialectic as a necessary new foundation for political philosophy. Marxism has long seemed to be dead, but perhaps capitalism is following it to the grave: if Hardt and Negri are the best guides we have to the future, then politics as a whole is in trouble.

More information on weak signals and on TERRA's work on emerging issues and on network dynamics can be found on www.terra-2000.org.

Policy Briefing - Examples of Emergent Issues

Many papers have been produced in TERRA expanding on newly emergent issues (or reinterpreting previously established positions) in the IST/sustainability nexus.

Six such topics were gathered together in a series of 'occasional papers' for TERRA. The first examines the importance of knowledge diffusion – specifically best practice – in accounting for the UK's relatively poor productivity growth in comparison to experience in the United States and Germany. It argues that the UK could make major improvements in productivity by adopting best practice, but identifies barriers to the effective adoption of the best techniques, with skills being the most important.

The second presents a high-level summary of the economics of human capital and the derivation of wage equations reflecting the impact of human capital on labour markets.

The third summarises some known facts relating to enterprise and high-tech small and medium-sized enterprises (SMEs). It looks in particular at the relative innovation performance of differently sized firms. The very smallest firms have dominated the growth of the SME sector in the UK for the past 15 years. But this growth, together with training and innovation has recently waned. This raises a policy challenge, especially as labour and management skills are now more important limits to growth than finance. High-tech firms are heavily embedded in networking and collaborative arrangements. It is thus important for policy to emphasise systemic issues. Moreover, this raises an important question about the balance of policy objectives between overcoming barriers to growth in small high-tech firms and influencing the network and collaborative infrastructure in which they work.

The fourth examines the economics of technical change and innovation and related policy issues. It takes as a central variable the global knowledge stock considered in the Human Capital theme (and NEMO before it) and examines the implications of its partial public-goods character. It also incorporates the recent literature showing that growth is faster in nations 'catching up' with those on the technological frontier, and draws the implications for European scenarios and policy.

The fifth essay documents a quick panel study of the relationship between schooling and growth performed using the Barro-Lee data set and other data, which supports the idea that (measured) educational *quality* is more important than (measured) educational *quantity* in explaining GDP growth.

The sixth essay collects some observations on the relation between inequality and growth from an economic perspective.

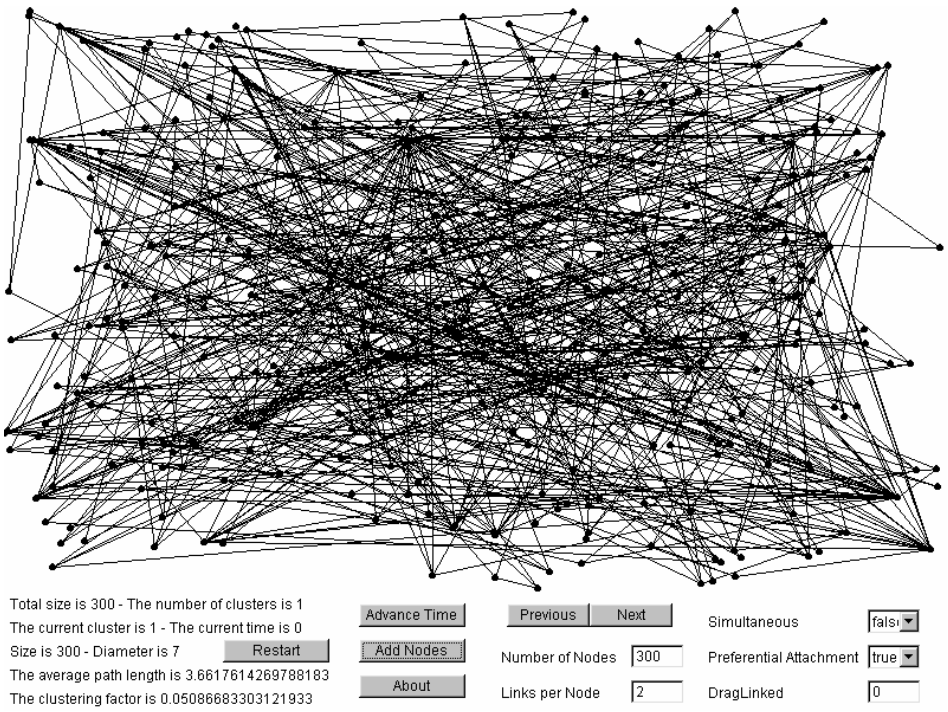
Policy Briefing – An Example Concerning Network Dynamics

A lot can be said about the characteristics of even seemingly random networks as long as some facts about the rules by which they are created, or their dynamic is driven, are known.

This leads to the understanding that information about emerging properties of networks can be found scientifically, so that using this information it might be possible to establish which frameworks can be created to steer the structure of the network (within known boundaries), that is as different environments influenced by and influencing the network dynamics.

TERRA's work on this topic was substantial but essentially exploratory, representing a response by the project to changing perceptions of the importance of network dynamics in work at the IST/SD interface. The Nautillus tools illustrated below are representative of an important area for future work following TERRA, rather than a completed TERRA task. They are located as the final note in the Story of TERRA as an apposite reminder that TERRA's work is of a type that can be (and is) finished, but which necessarily can not be (and is not) completed. There remains always much to be done: the editors of this document conclude with the hope that the work of TERRA will continue, albeit in different guises.

The NAUTILLUS© Networking Applet: a Random Network



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