A DRAFT PROPOSAL FOR THE ESTABLISHMENT OF A NEW TYPE OF RESEARCH INSTITUTE FOR THE TWENTY-FIRST CENTURY

by

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This is a proposal for a new kind of research institute, one designed to cope with the world of the twenty-first century. Two of the great problems of our age are (1) our inability to understand the pace of societal change, and (2) our difficulty of collecting and integrating the enormous amount of information produced by our new technologies. At present, even our best-informed politicians, scientists, or citizens have with only a limited perspective of where they are in the context of history and of where our societies are headed. The institute will be a model for the world in bridging the gap between the social and natural sciences—a divide which C.P. Snow lamented in his famous book "The Two Cultures", a set of concerns later echoed by Detlev Bronk, former President of the U.S. National Academy of Sciences, and by Jonas Salk, the founder of the Salk Institute and developer of the Salk polio vaccine. The world has become too complex for social scientists to live in separate environments from their colleagues in the engineering and natural sciences.

Most of us can easily provide numerous examples of the confused state of the world elites during the past century. Sometimes there was little capacity to understand the complexity of social change which was occurring, and the catastrophes and collapses which were about to happen. We must comprehend that over the past century—as well as at the present time—many of our most impressive societies have been far more fragile than contemporaries have realized.

First, there is the example of the Soviet Union and Eastern Europe. This was a system which was carefully studied by analysts both within and without the Soviet Union. Indeed, the American government had spent billions of dollars on intelligence and had established major centers in leading universities to train scholars in the languages encompassed by the Soviet Union as well as experts on the Soviet economy, geography, etc. Thus, the rapid disintegration of the Soviet Union and Eastern Europe was one of the most notoriously unanticipated developments of modern history. Had Western experts been polled in 1988, the near-unanimous opinion would have been that the dissolution of the USSR was highly unlikely, if not impossible in the near future. In short, this is a prime example of just how fragile complex social systems are and of our inability to comprehend their vulnerability or to predict their future.

Second, think of Berlin after World War I up to 1930 or even 1932. This was a city with more Nobel Prize winners than any other in the world. Berlin was the leading center in the world for science, music, art, and cinema. Germany in many industrial sectors was at the cutting edge technology. Germany had been both the real and spiritual home of Goethe and Immanuel Kant. And yet within a few years its world had also collapsed.

Modern societies live amidst a great deal of instability and volatility, and yet in the Western world there has long been a widely shared epistemological view of the world that it can easily be understood, manipulated, and managed by relying on the expertise of experts from

political science, sociology, or economics. Most specialists, although working within a particular discipline tend to be blind with respect to imminent and immanent social changes and even to radical re-structuring of their domain of studies.

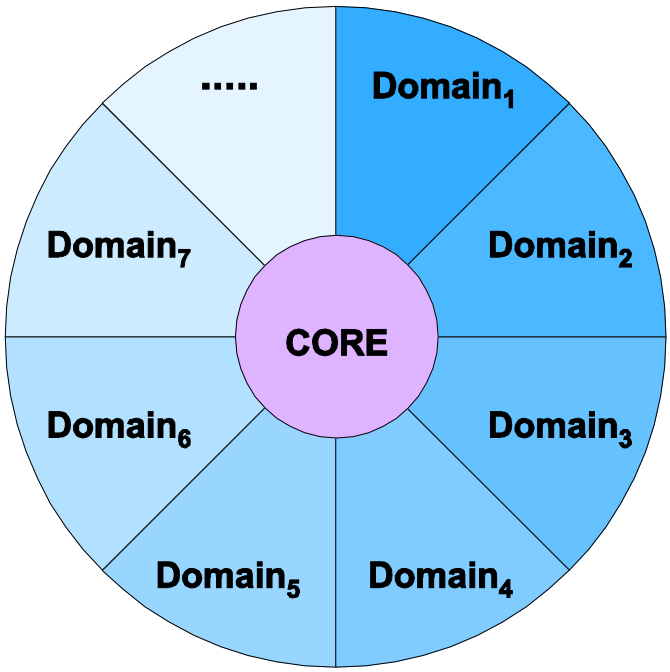
1 A New Kind of Trans-disciplinary Collaboration for the Twenty-first Century

To address the instability and volatility of our world, we need to reassess how the social sciences are cognitively organized and might better be linked with other areas of expertise in the natural, medical, or technical sciences. Many of the world's best-known research institutes are interdisciplinary, but we should reflect on whether the range of their interdisciplinarity is broad enough. Might the scientific community enhance their insights for research if they broaden their disciplinary perspectives and attempt to understand how useful their concepts are for scientists in more distant fields?

Most forms of inter-disciplinarity have generally involved weak forms of co-operation characterized by the state of peaceful co-existence among scientific disciplines. The linkages between disciplines have generally been restricted to a single cognitive interface, namely to problems and issues analyzed from different disciplinary angles and perspectives. It is important to add, however, that historically when participants from different disciplines addressed common problems the disciplines did not change and generally did not lose their autonomy. In many instances of interdisciplinary co-operation, a network of relationships, based on the use of common methods, models and mechanisms, have existed. Despite this sharing, experts in various fields have retained their autonomy for purposes of theory formation.

The type of interdisciplinarity we propose for the new institute is underdeveloped. We strive for a new and much more integrated connectivity among the participants in the proposed new institute, regardless of their disciplinary training and backgrounds. Our thinking is presented in Diagram 1. Here, there is a common theoretical core, consisting of a shared theoretical framework plus a common stock of models and mechanisms, that integrates a broad range of domains which are normally analyzed by different scientific disciplines. Diagram 1 gives an indication of this strong form of trans-disciplinary co-operation where a common core or a theoretical framework is shared by the entire group and the common core is used in different application domains D_1, D_2 to D_n, normally associated with different scientific disciplines and disciplinary competencies.

Diagram 1 A Strong Form of Trans-disciplinary Co-operation



A trans-disciplinary form of co-operation as shown in Diagram 1 seems broad and strong enough to tackle complex issues of societal change, unpredictability and information overloads as well as information transparencies. Unfortunately, one rarely finds this type of broad and strong co-operation institutionalized in research institutes.

2 Essential Cognitive Features of the Institute

We now outline a feasible and sustainable cognitive research organization which is able to reproduce and to maintain a strong form of inter- or trans-disciplinary co-operation over a period of time. Consistent with the general introduction of this proposal, the main agenda of this new institute is "to tame complexity" and to provide new insights which can lift the veil of ignorance - at least partially - and expand the current limits of predictability.

2.1 Goal of the Institute: Researching Rare Events, Unpredictability, Sustainability

The overall objective of taming complexity will be pursued by focusing on a class of processes which exhibit a special distribution, namely a high frequency of events with only marginal changes and a small number of rare events with radical and at times even disastrous changes. Both the social and natural sciences have an inadequate understanding of the conditions under which such rare events occur. Though both communities have advanced in their understanding of the conditions under which rare events are least likely to occur, scientists are still wrestling with the problem of where and when they are likely to occur. Because rare events with catastrophic consequences should be of major concern to all citizens, it is important that both the social and natural sciences collectively study such events.

Using the new trans-disciplinary mode of co-operation, the cognitive organization of the new institute should be structured in the following way. The overall objective of taming complexity will have a clear focus on a special class of processes which exhibit a special distribution, namely a high frequency of events with marginal changes and a small number of rare events with radical and at times even disastrous changes. Both the social and natural sciences have an inadequate understanding of the conditions under which such rare events occur. Though both communities have advanced in their understanding of the conditions under which rare events are least likely to occur, scientists are still wrestling with the problem of where and when they are likely to occur. Because rare events with catastrophic consequences should be of major concern to all citizens, it is important that both the social and natural sciences collectively study such events.

Mission Statement: The Institute is focused on the study of complex self-organized processes which also exhibit a power law distribution, i.e., a characteristic distribution of rare occurrences with very strong effects and frequent occurrences with marginal consequences only. Some occurrences with strong consequences have strong negative effects on societies. If the Institute studies these kinds of occurrences, it will also work on means and methods which can help societies at the regional, national or global levels to reduce the risks and to increase the protection from the negative effects of having major social costs.

At this point, we provide several examples of possible directions of research. Complex self-organization processes with characteristic power-law distributions with strong adverse effects can be found in

- the global finance system with rare occurrences of severe global crises like the ones in 1857, 1893, 1929 and a very large number of regional and local crises

- earthquakes with rare occurrences of very strong and disastrous quakes and a high number of marginal ones.
- forest fires with rare instances of wide-spread and long-lasting fires and a large number of small and highly localized fires
- the current global information and communication network with rare occurrences of major failures with wide-spread and disastrous consequences and a large number of small and local network defects

Thus, such an institute would focus on problems which are of persisting importance in the scientific community and also involve the well-being of the entire citizenry of the host country and other countries as well. Because of the small size of the institute, only three or four research problems will be chosen. Moreover, problem areas will change over time. The problems should not only be those involving the host country, but if the institute is indeed to be a model institute for the twenty-first century, the problems should be of high relevance for many other countries as well.

2.2 The First Cognitive Component: Self-Organized Criticality (SOC) as Common Core

As noted in the Mission Statement, self organized criticality (SOC) has been chosen as the integrative theoretical core (Bak, 1996). Self-organized criticality, including different models and mechanisms, constitutes, the common core shared by the different groups at the institute, irrespective of their disciplinary affiliations and competencies. The common core can be separated into the theory of self-organized criticality and a domain of models and mechanisms associated with the theory, as well as the relevant background knowledge needed in the construction of the theory and the models and mechanisms. In recent years SOC has become a generic term, covering a wide variety of complex processes in different domains which exhibit two essential features:

- On the one hand, these complex processes are characterized by the absence of a control or steering unit which is able to determine the overall performance of the process under consideration. Turning to the previous list of paradigmatic examples, one recognizes that all these processes fall under the self-organization requirement. Neither the global science production, the spatial concentration of new technologies, the diffusion of innovations, the re-direction of financial streams or the spread of earth-quakes is

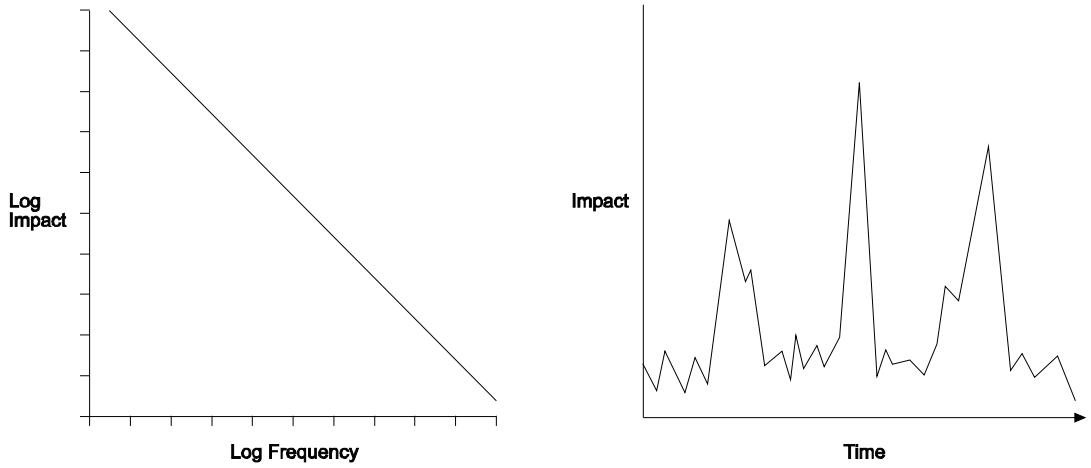
controlled by national or global control-units, be they states or international organizations.

- On the other hand, the self-organization process has to exhibit a special distribution with a rare occurrence of big events and a high frequency for small ones (Zipf, 1949). Diagram 2 presents a typical case of such a power law distribution which becomes the integrative empirical binding element throughout the research activities of the proposed institute.

Diagrams 2a and 2b summarize the empirical distributions and temporal patterns of SOC processes. Diagram 2a exhibits the characteristic power law distribution with few large occurrences and many small ones and Diagram 2b shows a stylized picture of a typical time-series of an SOC-process.

Diagram 2 Two Schematic Representations of Power-law Distributions

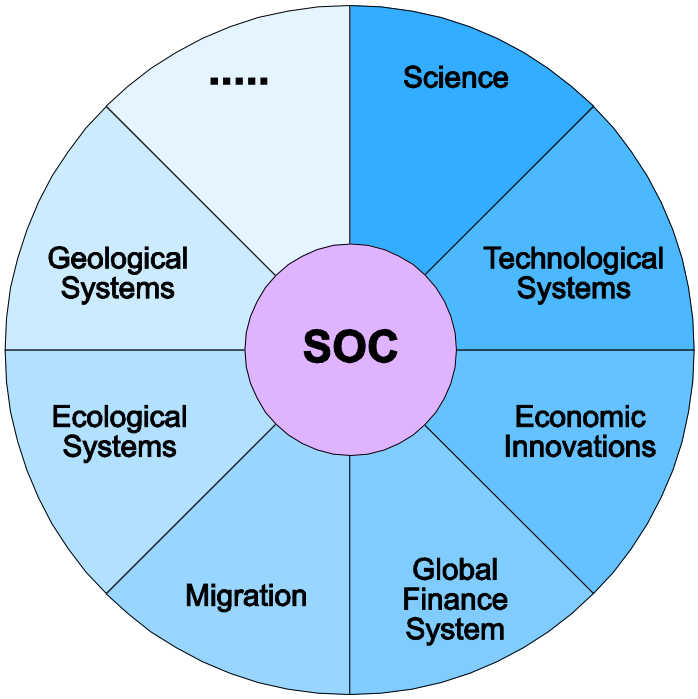
2a: The Distribution of Occurrences and Impact **2b: The Distribution over Time**



2.3 The Second Cognitive Component: Trans-Disciplinary SOC Applications

The common SOC core can be used in a wide range of domains which fall under the competencies of different disciplines such as science and technology studies, economics, sociology, political sciences, biology, ecology, geology, physics and the like. Diagram 3 points to a variety of potential areas of application where one can observe SOC processes. In the context of the new institute, these application processes will be studied with small research teams with substantial competencies both in the common core and in the specific domains of application.

Diagram 3 The Second Cognitive Component for the New Institute – SOC Applications across Natural and Societal Domains



In the subsequent paragraphs one finds a small selection of potential fields of studies of SOC-processes and phenomena..

Global and Regional Financial Systems

Because rare events occur so infrequently, most policy makers and economists tend to think that their societies are immune to economic crises. For example, most economic forecasters were surprised by the world depressions of 1857, 1893, 1929, the collapse of the equity and housing markets in Japan in the early 1990s, the collapse of the technology equity market in the U.S. in the late 1990s, and the financial crises of several Asian economies in the 1990s. At the moment, some of the world's most sophisticated international economists believe there is the potential for a serious global economic crisis, and yet, policy makers and financial analysts in Washington, New York, London, and other major centers tend to be oblivious to the danger signals. But if policy makers and researchers were to engage in serious retrospective analysis of the rare events of previous economic crashes, policy makers and well-educated citizens would be less surprised next time such events occur. Capitalism is an extremely efficient system for coordinating economic activity, but it is also a system with varying degrees of volatility and instability. And when a rare event such as a major economic crisis occurs, whether

regional or global, its consequences for many citizens can be quite devastating. Because such crises can be disruptive of most economic activity—including universities and other research organizations—it would be useful for social and natural scientists to integrate their theoretical and methodological skills in order better to understand such events and to minimize their consequences when they occur.

Geological Systems and Earthquakes

With respect to geological formations, we know from retrospective and other forms of analysis where major fault lines exist and that major earthquakes are going to continue occurring—but perhaps with even more devastating consequences unless societies urgently prepare to cope with such events. We now know that many major fault lines are located on river beds. Because of their desirable locations, the processes of rapid urbanization over the past century and a half have resulted in greater concentrations of people living directly on major fault lines. As a result, major earthquakes when they occur are likely to result in greater loss of life than previous earthquakes.[1]

One could add numerous other examples for power law distributions and their societal impact. It is hoped, however, that the small list already is sufficient to point to the high relevance and to the immediate concern of a trans-disciplinary in-depth study of this broad range of processes.

[1] It is worth pointing out that Ljubljana is a city located on a major fault line, and seismologists are confident that there will continue to be earthquakes there. Fortunately, preventive measures can be taken to reduce the devastation when the next earthquake occurs.

Ecological Systems

Following Per Bak (1996) and many others, ecological systems exhibit a considerable number of SOC processes like forest fires or the distribution of species. Here, the policy relevance differs widely across countries, depending on the scope and dimension of their ecological systems, including their geomorphology. Nevertheless, issues like forest fires (Jensen, 1998) or landscapes out of balance exert a considerable impact and strains on existing societies. Additionally and even more importantly, rare events whose impact lies in a large-scale mass-extinction within an ecological system fall into this category as well. Furthermore, the formation of new bacteria and viruses with a strong impact on human health which, once again, follows the SOC pattern adds another potentially highly relevant issue in the domain of eco-systems.

Technological Innovations and the Economic System:

Innovation processes exhibit a power-law distribution since during any period one finds numerous marginal or incremental innovations and only a few number of path-breaking or basic innovations which change the whole technology landscape dramatically like in the case of railroads in the 1850s and 1860s or the automobiles a century later. While basic innovations and their impact of creative destructions have, following the path-breaking analyses of Joseph A. Schumpeter, long-term beneficial consequences for advanced societies, they still pose a large number of relevant policy issues like the protection of existing industrial or service sectors.

The Global Science System

The rapid increase of scientific articles and journals does not only lead to a substantial information-overload, but also to serious policy issues with respect to the relation between science funding and outcome. Viewed as a SOC process, the scientific output is subject to a power law where, following an example given by Nicholas Rescher (1982), an increase in the number of scientific articles by a factor of ten will produce only a marginal increment in high quality output.

Technology Diffusion

Ever since the emergence of Silicon Valley in Northern California some decades ago, societies in both Asia and Europe have invested the equivalent of billions of dollars attempting either to mimic the Silicon Valley phenomenon or to develop something comparable. So far, efforts to replicate the Silicon Valley phenomenon have not been very successful. These efforts raise an intriguing research question: is it possible to plan such large-scale, complex sites—or do they evolve from the particular structure and site distribution of the global technology system? Within the SOC context, the distribution of the size of technological agglomerations should exhibit a power-law distribution, and thus would impose almost insurmountable restrictions for policy efforts to imitate and to surpass an already existing very large agglomeration of units.

Likewise, the global internet has evolved into a state which is subject to a power law distribution for network failures and defects which leads to new sets of problems of network security aimed limiting the diffusion of serious network failures.

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Migration and Urban Agglomeration

Migration and horizontal mobility processes have long been recognized as a paradigmatic case for power law distributions. Georg K. Zipf in his prolific and pioneering study of power-law processes (1949) presented ample evidence of rank size distributions of cities in different countries across the world. In large parts of the developing world, the agglomeration of large cities and the corresponding mobility away from rural areas has set forth a permanent revolution which seriously endangers the sustainability of tomorrow's mega-cities like Bangkok, Cairo, Hyderabad, Lagos, Mexico-City or Sao Paulo.

2.4 The Third Cognitive Component: Societal Protection and Risk Reduction

As a special feature of the proposed institute, a third cognitive element will be added which is mainly concerned with the overall consequences and the impact of theorizing and modeling SOC processes for contemporary societies, regional, national or global. In practice, each permanent working group at the proposed institute is supposed to work, in the course of their project, on all three components and provide fresh answers across all three areas.

More systematically, the small list of paradigmatic examples already indicates that SOC processes may have long-term beneficial effects like radical breakthroughs in the knowledge landscape or basic innovations in the economic system or highly adverse effects like severe financial crises, earthquakes or natural disasters. The overall topic of societal protection and risk-reduction refers to this latter group whereby contemporary societies should be provided with adequate means and instruments for prevention and damage-control. Table 1 as well as Diagram 4 present a summary of the main cognitive tasks within the third component of the cognitive structure of the new institute.

Table 1 Main Tasks for the Third Cognitive Component

Strategies, Policies, Programs	
ex ante	ex post
Prevention	Damage-control
Robustness	Infrastructure Maintenance
Sustainability	Rescue

Diagram 4 Relevant Tasks for the New Institute: Prevention, Risk-Reduction and Rescue based on SOC Theory and Modeling Applications

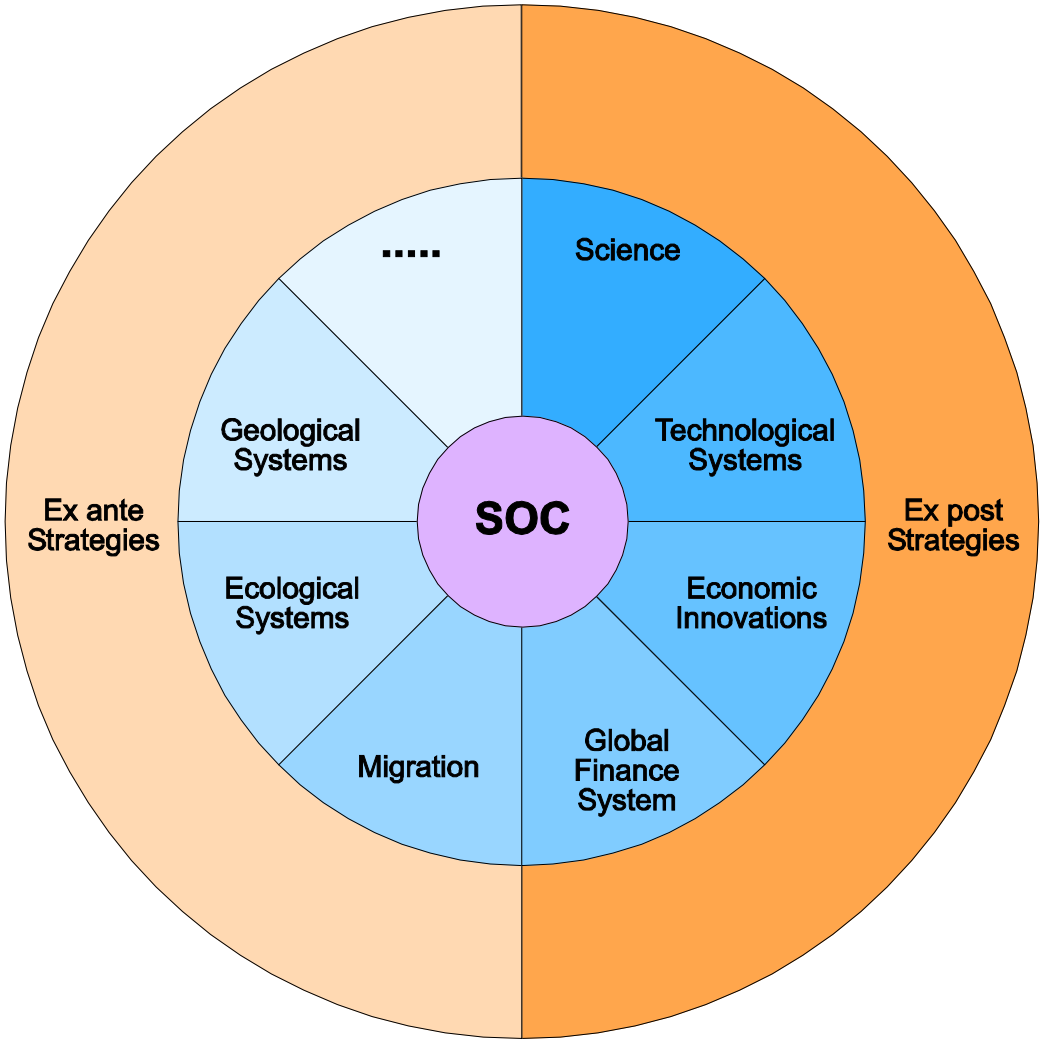

Table 1 addresses extremely important questions which should involve the collaboration of social scientists, natural scientists, engineers, as well as policy makers. While there is currently some modest literature on this subject, they are neither dealt with in a comprehensive and encompassing manner, let alone in a theoretical SOC context so that these issues should be

prime candidates for research in this proposed institute. Ideally two, three or four individuals in the institute might focus their attention on a specific SOC project, but over a period of years a number of non-resident scholars might also go to the institute and collectively a great deal of collaboration might emerge on this subject.

As this proposal suggests, the scholars in the institute will study areas of societies in which processes of self organized criticality occur. But they will also design programs and plans for societies to address the consequences of these processes. As Table 1 suggests, scholars in the institute will propose policies and plans to cope with large scale disasters before they occur, in an effort to prepare societies (ex ante processes) There will be efforts to sustain a high quality of life even in the face of disasters (e.g., sustainability). In short, there will be plans to rescue societies from disasters.

We present four examples of how institute participants might work within the third cognitive ring while addressing the four tasks in Table 1.

Governance and Transparency Issues

SOC as a common reference frame leads to an immediate recognition that our traditional theories of democracy and governance are somewhat antiquated. Actors are on a day-to-day basis nested in a complex world and the decisions determining the quality of our lives are not made exclusively at the level of the nation-state, Rather, some decisions are shaped at the global level (e.g., the rate of interest which influences the costs of our mortgages for homes, automobiles, the value of our currency); other decisions are made at a trans-national regional level (e.g., the European Union), the level of the nation-state, or the sub-national region level (e.g., local or regional levels). On a daily basis decisions involving the nature of our societies are made at each of these levels, but our societies have no effective means for coordinating decisions at each of these multiple levels. Indeed, the need to develop effective means of coordinating decisions at each of these levels is one of the most challenging issues of our time. A global economic crisis, a crisis involving the rapid spread of diseases (e.g., avian flu, AIDS) are only a few issues which involve the need for effective coordination or governance at multiple levels of reality, but at present we have inadequate institutions and theories for how to effectively address such issues at multiple levels simultaneously within an overall SOC context.

The recurring crises within the SOC context pose not only serious challenges for new forms of governance, they also require a fresh and catalytic thinking about how to manage serious crises, once they occur. As our societies become ever more dependent on accessing, retaining, and using data in a machine readable form, our societies already suffer from mild symptoms of a collective amnesia. As innovation in software and high speed computers rapidly render yesterday's technology obsolete, our societies risk losing the capacity to record and

recover data about the past even under normal operations. Thus, keeping the relevant data alive and transparent is necessary for retrospective analyses if our societies are to have sophisticated understanding of epidemiology, demography, or employment. Moreover, without data about past events, our societies cannot rigorously assess the frequency of floods, forest fires, or air pollution.

Designing Robust Buildings and Infrastructure

We know from experience in Japan and California that improving the architectural design of buildings and regulating their location can reduce the consequences of such natural disasters as earthquakes, hurricanes, mudslides, forest fires, etc. Unfortunately, if the market is not tamed to regulate the location and quality of buildings, the consequences can be quite devastating—witness the severe hurricane damage in New Orleans and the earthquake damage in Pakistan in 2005.

Programs for Robust Information Infra-structures in Periods of High Crises

Problems of information and information infra-structure accumulate almost exponentially in periods of severe crises where segments of the relevant information infrastructure are no longer operating normally. Thus, the over-riding task in this area is focus on robust forms of information-infrastructures which can be used and relied upon even under adverse circumstances of severe regional or national crises.

The Use of a Special Military Force to Cope with Natural Disasters

A small country such as Slovenia could be a model for the entire world by training its military to respond quickly to natural disasters. The American military is trained to be a major fighting force, but when hurricane Katrina hit New Orleans in 2005, the military proved to be quite incompetent to respond to the catastrophe. On the other hand, the military of small countries—such as Slovenia—do not have the capability to be a major fighting force, but they can become a role model for great and small powers alike by training their military to respond rapidly to natural disasters. Such a model would be very valuable for other societies which experience not only earthquakes but also hurricanes, tsunamis, tornados, dangerous forest fires, nuclear accidents, etc. All of these types of major accidents will continue occurring throughout our lifetimes.

Another improvement to cope with natural disasters is constant training of hospital and other medical personnel to respond quickly with expert skills to a variety of types of disasters, such as airplane crashes, nuclear accidents, earthquakes, hurricanes. Because each type of disaster is different, emergency personnel must be constantly trained to deal with the heterogeneity of events which will inevitably continue to occur in the future.

3 Organizational Characteristics of the New Institute

In this section the organizational design of the new institute is presented in greater detail.

3.1 The Santa Fe Institute (SFI) as a Model

With respect to the organizational design, the paradigmatic example for the proposed institute is the Santa Fe Institute which was founded in 1984 with the mission of transdisciplinary research, fulfilling the standards of excellence. While the Santa Fe Institute has focused on complex processes in general, the institute proposed herein will differ from the SFI in two important respects:

- First, the focus will be on a special set of complex self-organizing processes.
- Second, it will address the impact of self-organizing processes for societies at regional, national or global levels and it will provide fresh policies, strategies and programs for action and intervention to reduce the risk and increase the sustainability of contemporary societies.

Like the SFI, the new institute will be designed to influence scientific research in other organizations, as well as to ensure the development of the sciences of complexity. The new institute will have a modest educational component, primarily limited to the development of summer programs, modelled after the famous summer institutes at Cold Spring Harbor (New York), which subsequently resulted in the awarding of a number of Nobel prizes.

The new institute, like the SFI, will be primarily a visiting institution. At any given time, a very high proportion of those doing research will be non-resident scholars, most of whom will have appointments of less than one year. There might be postdoctoral fellows, with appointments from 1 to 5 years. A constant inflow of visiting personnel should assure, like the SFI case, the freshness of research and vigorous external criticism and the constant diffusion of new ideas. The new institute, like the SFI, will have a small number of permanent positions only.

3.2 Size and Personnel

Like the SFI, the new institute will be small in order to maintain its organizational design of trans-disciplinary co-operation. Ideally, the institute should never have more than 20 to 25 scholars. Most of the scholars will be from the host country, but there will be extensive possibilities for international visitors. Ideally, visiting scholars will be in residence for three or four months, but they might return on multiple occasions. (The model here is the Salk Institute in La Jolla, California which early in its history had non-resident scientists who spent three or four months in multiple years. Subsequently, the following non-resident scientists at the Salk were awarded Noble Prizes: Francis Crick, Gerald Edelman, David Hubel, Jacques Monod, and

Torsten Wiesel. In short, the non-resident scholars for the new institute would be individuals of extraordinary talent).

3.3 The Advantage of Small Institutes and of Locating Such an Institute in a Small Country

The Comparative Advantage of Small Institutes

Professor Rogers Hollingsworth has specialized in studying the organizational environments where major breakthroughs in basic science are most likely to occur. His findings, based on the study of research organizations in many countries, reveal that major breakthroughs are more likely to occur in research organizations which (1) are relatively small, (2) have a moderately high degree of scientific diversity, (3) have the ability to facilitate intense and frequent communication among the institute's scientists in diverse fields, (4) have scientific leaders who have a good sense of the direction which research should go in order to make major discoveries, (5) and have a high degree of autonomy and flexibility. Hollingsworth has studied in some depth the following research institutes: numerous Kaiser Wilhelm and Max Planck Institutes in Germany, the Institut Pasteur in Paris, the Laboratory of Molecular Biology in Cambridge (U.K.), the Basel Institute for Immunology, the Salk Institute for Biological Studies and the Scripps Research Institute—both in La Jolla, California, the Rockefeller Institute in New York City, the Institute for Advanced Study in Princeton, New Jersey, and the Bohr Institute in Copenhagen. Each of these institutes has had major discoveries resulting in the receiving of a Nobel Prize. Indeed, according to Hollingsworth's data, small institutes are far more likely to have major breakthroughs than large research universities which tend to be fragmented and differentiated into many disciplines and sub-specialties with little communication across different fields. Moreover, as universities have become larger, they have tended to become more bureaucratic and to lose their flexibility and capacity to adapt to the rapid development of new knowledge.

The Comparative Advantage of Locating Small Institutes in Small Countries

The key to promoting fundamental new knowledge is facilitating intense and frequent communication among scientists in diverse fields. In large countries such as the United States, Germany, and the United Kingdom, there is so much scientific specialization that scientists in diverse fields tend to have relatively little intense and frequent interaction with each other. Scientists in specialized fields or niches in large countries often organize their own programs and institutes. This is not inevitable, for as the above text suggests there have been small institutes in large societies where intense and frequent interaction takes place. But generally, the

larger the society, the less likely that scientists in diverse fields will know one another and interact with one another. Niels Bohr's institute in Copenhagen was a marvelous example of the potential for bringing scientists in a small country from the natural and social sciences together in order to promote common problems. There is some evidence that it has been more feasible to fund a small institute with scientists from diverse fields in a small country. Moreover, if a small institute in a small country in the European Union attempts to establish a model institute for the twenty-first century and makes the institute accessible to scientists across a particular region of the European Union (E.U.), there is a distinct possibility that it can attract E.U. funding. And if such an institute becomes a genuine model for the twenty-first century, it should have a strong likelihood of obtaining funding from such international private foundations as the George Soros Foundation, the Ford Foundation, the Wellcome Trust, or the Wallenberg Foundation.

3.4 Physical Facilities

From a practical point of view, the institute may initially have to be located in an existing research organization. Should such an institute be located in Ljubljana, it might be located at the Jozef Stefan Institute or at the University of Ljubljana. Based on Hollingsworth's data on successful institutes, however, it is important that there be a common venue and time where members of the institute would be expected to engage socially and intellectually multiple times a week. This might be for tea, lunch, or some other such occasion. Within a few years, however, the institute would be expected to have its own separate facility.

4 An International Advisory Council

If the goal is to be realized of establishing a model for a twenty-first century institute for bridging the natural and social sciences, the proposed institute must have an advisory council of scholars of international distinction from a variety of disciplines and countries. Such an international group of scholars should not possess a preconceived ideological set of prejudices nor should the individuals have strong ties or allegiances to any existing political party or to any organizational interest group within the country where the institute will be located. Overall, the international advisory council should have no more than 15 members, for if the council is too large, individual participants might not consider their presence to be vital at meetings. The following is a list of individuals of the type needed for such a council. The drafters of this proposal know all of these individuals extraordinarily well and can arrange for them to serve if invited. Obviously, additional names for the international advisory council will be proposed as plans for the development of the institute progress.

1) Professor Günter Blobel, Nobel laureate and Professor at Rockefeller University in New York City. Blobel is one of the world's foremost biologists. He is German by birth but has spent most of his professional career at Rockefeller University—which despite its name is essentially a relatively small research institute. Blobel has considerable wisdom and experience to bring to a small interdisciplinary institute with the goal of building bridges between the natural and social sciences.
2) Professor Robert Boyer of the École des Hautes Études en Sciences Sociales (EHESS) and Centre Pour la Recherche Economique et ses Applications (CEPREMAP) in Paris. Boyer was trained in one of France's elite grandes écoles as an engineer but has emerged as one of the world's leading mathematical and institutional economists. He is an extraordinarily productive scholar and has been the director for some years of an elite, small international research institute in Paris.
3) Professor Gerald Edelman, Nobel laureate and Professor of Neurobiology at the Scripps Research Institute and the Director of the Neurosciences Institute. Both of these institutions are relatively small research institutes in La Jolla, California. Previously Edelman was a scientist at Rockefeller University for approximately 30 years. In addition, Edelman was formerly chairman of the board of the Basel Institute for Immunology—a small institute—at which on three separate occasions a Nobel Prize was awarded to a scientist while Edelman was chairman of the board. Edelman was formerly a non-resident scholar at the Salk Institute—another small research institute where a number of Nobel laureate scientists worked. Edelman is a broad thinker—a man who throughout his career has internalized considerable scientific diversity.
4) Professor Rogers Hollingsworth of the University of Wisconsin (Madison), the University of California San Diego, and the Neurosciences Institute (in La Jolla). Hollingsworth has done more research on the establishment of small research institutes than anyone else. He is the author of numerous scholarly books and articles and as a result of his research he has received honorary doctorate degrees on both sides of the Atlantic. In addition, he serves on the funding councils of several European science organizations.
5) Dr. Karl H. Müller of Vienna, Director of the Wiener Institut für sozialwissenschaftliche Dokumentation und Methodik (WISDOM). He is a prolific scholar in the sociology and philosophy of science as well in the field of applying complex models to the analysis of societal dynamics. Recently, he developed a general framework for the analysis of innovations and for the emergence of new processes and phenomena under the heading

of an epigenetic research program. He has had considerable experience in studying research institutes and has extensive connections with the scholarly community on both sides of the Atlantic.

6) Professor Wolfgang Streeck, Director of the Max Planck Institute for the Study of Human Societies in Cologne, Germany. Streeck is one of the world's leading sociologists, is a member of the Prussian Academy of Sciences, the author of many books and articles, and has had considerable experience in being a director of one of Germany's leading Max Planck Institutes. He also was formerly at the Wissenschaftszentrum Berlin für Sozialforschung and a professor in the leading sociology department in the United States (The University of Wisconsin).
7) Professor Anton Zeilinger of the University of Vienna. Zeilinger is one of Europe's leading physicists who trained in both Europe and at MIT. He has long had an interest in the development of small international and interdisciplinary institutes with a high commitment to excellence.
8) Professor Richard Whitley of the Manchester Business School (U.K.). Whitley combines several research specialties. He is one of the world's leading scholars who studies how organizational environments facilitate high levels of innovativeness in both basic science and technology. He has studied organizations in many countries, including Hungary and Slovenia. His knowledge of both the natural sciences and social sciences would be very valuable for the kind of research institute we are proposing.
9) Professor Bjorn Wittrock, Director of the Swedish Collegium for Advanced Study in the Social Sciences (SCASSS) in Uppsala Sweden. Wittrock has been director of SCASSS for approximately two decades. He has had considerable experience in writing about both the social and natural sciences. He would bring considerable skills to the proposed institute in that for many years he has been either a consultant or member of the governing board of a number of distinguished research institutes in a variety of countries: the Institute for Advanced Study (Princeton, New Jersey), the Institute for the Behavioral Sciences (Palo Alto, California), the Wissenschaftskolleg zu Berlin, and the Netherlands Institute for Advanced Study.

The above list represents scholars (1) who have had considerable experience in working with and/or studying small institutes of high excellence, (2) who are held in high esteem by the international scholarly community, (3) who individually internalize a great deal of scientific diversity, and (4) who collectively come from a variety of scholarly traditions and societies. This diversity of perspectives offers the potential for constructing a highly innovative and creative

institute. Indeed, such traits are probably prerequisites for establishing a model of a new type of institute for the twenty-first century.

5 Time-table for Launching the New Institute

There is no absolute way of determining when such an institute should be launched. However, an ideal moment would be when a small society's political leader (e.g., prime minister, president) assumes the Presidency of the European Union. This would provide the occasion to gain the attention not only of the entire European Union but of the World. Such attention fixed on the idea of such a new type of institute could do much to facilitate the generation of funding not only from the European Union but from private foundations from both sides of the Atlantic. The individuals listed as proposed members of an advisory council have very good contacts with potential donors.

Regardless of when the institute is actually launched, there should be as soon as possible (i.e., 2006) a small international workshop to begin discussions for such an institute.

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