The GB Protocol

Research plan & institution-building strategy
The Global Brain Institute, 2017-2021

(...) the main applications of the Internet are likely to become integrated into a single, universal system for coordinating all the activities of the people and machines on this planet. Such a system would immensely reduce the confusion, friction and waste caused by poorly aligned activities, while boosting the synergy of collaboration. Complemented by on-going technological innovation, the resulting increase in productivity would create an economy of abundance (...), where all needs can be satisfied at negligible costs. The combination of abundance with an intelligent, bottom-up system of coordination should eventually produce a solution for all the major problems that plague humanity, including global warming, poverty, inequality and conflict. (Heylighen 2016)
Executive summary

In its first five years, the Global Brain Institute has investigated how the Internet could develop into a distributed intelligence that would coordinate human and technological activities at the planetary scale. For this, we developed a conceptual and mathematical theory of the self-organization of distributed intelligence, and compared its implications with present technological and social developments. This provided us with a long-term scenario for the emergence of a Global Brain that would be able to tackle all our major problems, but also with some concrete strategies for supporting this evolution.

Building on these results, we now propose a roadmap towards the actual development of a Global Brain. The strategy is similar to the one that led to the creation of the World-Wide Web: specify a universal, open protocol that would allow all people and machines to intelligently coordinate their actions, independently of platforms, languages, or governance structures. We have already formulated the conceptual foundations of that protocol in our mathematical models (Challenge Propagation, COT, and Offer Networks). But its concrete elaboration requires much further analysis, modelling, implementation, and testing in real-world situations.

The protocol will consist of several application layers, which each add further intelligence and functionality to the whole, and which can be developed relatively independently. Thus, the Global Brain network can be built up step-by-step according to our proposed roadmap, assimilating increasingly advanced technologies as they become available. These technologies include the Semantic Web, Internet of Things, reputation systems, Decentralized Autonomus Organizations, and ecosystem modeling.

The main requirement for realizing it at the world level is that the protocol would prove its usefulness clearly enough, so that an increasing number of people start using it, until it encompasses all Internet connected systems. This is similar to how Tim Berners-Lee’s HTML/URL protocol eventually integrated all computers and documents into the World-Wide Web. We propose a further integration that would allow the network to match the needs, resources and actions of human and technological agents at all scales. The resulting gains in synergy, efficiency and coordinated action could in principle solve the major economic, social, ecological and organizational problems that the world is confronted with—including inequality, poverty, unsustainable growth, waste, and poor governance.

We see our mission as guiding the emergence of the Global Brain—in contrast to merely forecasting its likely properties. As socio-political confusion and turmoil spread across the globe, our society is approaching a transition towards a fundamentally new social, economic and technological regime. We believe that the time is ripe for promoting a rational, feasible, and genuinely optimistic vision of the future of humanity, in which an increasingly intelligent Internet mediates human and machine interactions towards the common good. Our theoretical research has prepared us for the elaboration, prototyping and testing of a protocol that would practically support such intelligent mediation.

For us to realize this aim, our conceptual readiness must be matched with a corresponding organizational power. Therefore, the current document extends our basic research plan with an institution-building strategy. It is aimed at the radical strengthening of the Institute as a research center, at assuring its future financial sustainability, and at promoting the global impact of our results.
1. The GBI research plan for 2017-2021

Introduction

The Global Brain Institute (GBI) was founded in January 2012 at the Free University of Brussels (VUB) to research the emergence of a Global Brain (GB), i.e. the evolution of the Internet towards a system of distributed intelligence that far surpasses individual human intelligence. During the first years of its existence (2012–2016), with the support of a research grant from the Milner Foundation, the Institute has developed a conceptual framework, a mathematical model, and a rudimentary computer simulation of how distributed intelligence can emerge from Internet-mediated interactions. Simultaneously, the GBI team has been exploring a wide range of related issues and applications, including various innovations in technology, Internet platforms, the sharing economy, and methods of distributed governance. This has given us clarity and confidence about the scope of the phenomena to be investigated and the methods needed to deal with them. Thus, our research is ready to have a significant impact on both science and society.

The Global Brain encompasses both human and technological agents and systems, and the network of connections through which they coordinate their actions. Thus, GB research is by its nature interdisciplinary, relying on insights from widely disparate fields. These include complexity science, cybernetics, economics, management, psychology, artificial intelligence, computer science, philosophy, ecology and sociology. Given the complexity of this domain, our work in developing a synthetic theory was very hard, but—we believe—ultimately successful.

Our initial approach was based on a multi-agent model, in which human or technological agents would propagate challenges along links in a social network (Heylighen, 2014; Heylighen, Busseniers, Veitas, Vidal, & Weinbaum, 2012). In its attempts to include all the most important relevant factors, however, this model quickly became unwieldy, as the variety of parameters made it difficult to interpret the results, either numerically or conceptually. Our search for a simpler approach resulted in a conceptual and formal framework that is more general, elegant, and powerful, while still building on our theory of challenge propagation.

The new model is based on the formalism of Chemical Organization Theory (COT) and its interpretation in terms of Offer Networks (ON). The COT formalism provides a domain-independent mathematical language for describing self-organizing and self-sustaining networks of reactions, independently of the agents that may or not be involved in these reactions. That allows it to model phenomena as diverse as ecosystems, social systems, and economies, as well as their interconnections. Offer networks are a new paradigm for conceptualizing and automating exchanges and the sharing economy, by means of an intelligent computer network that finds sophisticated matches between offers and needs. Together COT and ON propose a foundation for a Global Brain that would intelligently coordinate all problems, challenges or needs with the actions, resources and agents available to tackle them. This foundation can be elaborated and implemented step-by-step, thus creating an increasingly powerful system able to solve an increasingly broad array of local and global problems. We will now explain our strategy for building such a system in more detail.

Rationale

Our world is confronted with a wide variety of problems: growing inequality, climate change, conflicts, poverty, loss of biodiversity, instability, unsustainable use of natural resources, increasing stress and depressions, technological unemployment, and many others. Because of accelerating globalization and hyperconnectivity, all these problems are interdependent, as events in one domain (e.g. global warming) affect another domain (e.g. floods), which in turn affects another (homelessness and disease among those affected), and yet another (migration).
In principle, each of these problems can be tackled by existing—or soon to be developed—technologies. For example, global warming can be tackled through solar energy and more efficient energy use, and loss of biodiversity through more sustainable farming methods. Therefore, several technology forecasters foresee a world of abundance (Diamandis & Kotler, 2012; Drexler, 2013; Rifkin, 2014), where any deficiency can be resolved by hyperefficient technologies.

However, such technologies typically offer piecemeal solutions, which address a single deficiency, while ignoring the complex, nonlinear interactions between all the different problems and opportunities. These interactions create a highly unpredictable situation that is excruciatingly difficult to manage, and that has been described as Volatile, Uncertain, Complex and Ambiguous (VUCA) (Beigi, 2014; Bennett & Lemoine, 2014). Traditional methods, which use planning based on a simplified model of a well-defined system, are unable to deal with the ‘wicked’ problems of such a VUCA world. The science of complex adaptive systems (Axelrod & Cohen, 1999; Ball, 2012; Miller & Page, 2007) proposes an alternative way of dealing with such irreducible complexity: distributed self-organization. Many different agents, each of which each only has very limited information, may eventually learn to coordinate their actions so that the system as a whole self-organizes and eventually adapts to any challenge (Heylighen, Cilliers, & Gershenzon, 2007). But that demands an efficient medium for these agents to interact, so that effective win-win arrangements can be discovered and propagated to others.

In principle, the Internet already provides us with a flexible medium for the communication between all human or technological agents. The Internet is founded on the TCP/IP protocol, which provides a universal, unambiguous and robust set of codes and methods for transmitting data between any connected computers. But data are not yet knowledge. Tim Berners-Lee therefore created another set of universal protocols (HTML, HTTP, URL) that would turn the Internet into the World-Wide Web, and eventually into the Semantic Web (Berners-Lee & Fischetti, 1999). Documents residing on different computers could now be linked into a single web of knowledge, whose hyperlinks are similar to the associations in the human brain (Heylighen, 1994; Heylighen & Bollen, 1996).

However, the brain is more than a vast library of interlinked documents: it is an active process where millions of neurons are firing simultaneously in order to process information, make decisions, build new connections, and coordinate all the different activities in the organism. Similar processes are taking place in a distributed manner across the Internet, e.g. when people post messages that are seen and commented by others, search for knowledge or products to buy, or remotely control devices. We have described these processes as the propagation of challenges (Heylighen, 2014), where a challenge is a situation or message that “activates” an agent to perform some action, just like a neuron “activates” the neurons it is connected with by passing on its (electrical) action potential.

Present-day Internet interactions lack the universality, coherence and self-organization that characterize neural processes. In the brain, neurons, synapses, neurotransmitters and action potentials define the common protocol that all brain components understand, allowing them to work together in a highly coordinated manner. In contrast, the present Internet uses a variety of independent platforms, with different rules, different user communities, different interfaces, and different protocols. Thus, a challenge posted on one platform will in general not be able to propagate to agents using a different platform, or to be tackled in a coordinated manner with other challenges, even within the same platform. That is why the “global brain” formed by the Internet is as yet a rather primitive, confusing and inefficient system for tackling global problems.

Inspired by our observations and models of challenge propagation and action coordination in this primitive brain, we have come to the conclusion that a much more efficient, coherent organization of these processes is possible. But that requires a next step in the formulation of networking protocols. The new protocols will need to address not data, documents or links, but processes of propagation and coordination that directly address the different challenges encountered by the global organism.

These protocols should be public, universal and easy to use, so that any person with a computer, smartphone or other Internet-connected device can rely on them, without any technical knowledge or need for licensing. They should be independent of vendor, platform, software or hardware, so that any problem
entered by some agent can be matched with any element of a potential solution entered by some other agent. They should be able to describe any need, offer, or complex of actions that may lead from the one to the other. They should support the self-organization of coordination across the global network, so that the actions performed by initially independent agents can produce a coherent organization.

Once the protocol is implemented on a number of publicly accessible computers, so that its usefulness becomes clear, others are likely to implement it on their machines as well, so that these become part of the growing "Global Brain" network. The more people use it, the more resources they will make available through it; the more useful it will become, and therefore the more people will use it. The resulting virtuous cycle would be similar to the one that led to the phenomenal growth of the Internet (based on the TCP/IP protocol), of the World-Wide Web (based on HTML/URL), and of Wikipedia (based on the Wikimedia protocol). Because these protocols are open-source and non-proprietary, their spread was not hampered by commercial restrictions, IP protection, or competing, mutually incompatible platforms, and therefore their adoption was truly global.

But for this to become a reality, we need to define a public protocol that can dependably describe all possible needs or problems, resources or solutions, and the processes that match the ones with the others.

**Offer Networks and the COT formalism**

The foundation of our proposed protocol is what we have called the action ontology (Heylighen, 2011; Heylighen & Beigi, 2016). This is a generic way of representing complex systems in terms of their elementary processes, or “actions”. Actions are coupled when the output of the one forms the input for the next. All actions coupled together form a recurrent network along which activity propagates (Heylighen, Beigi, & Veloz, 2015).

Such actions can be formalized as production rules or condition-action rules (Anderson, 2014). These have the form: a → b, to be read as "if a, then b". or more precisely: "if condition a is present, then perform an action producing condition b". Systems of production rules have an extensive history of application in Artificial Intelligence (AI), where they are used to solve problems by performing the appropriate sequence of inferences. But this assumes that the problem to be solved is well defined, so that it can be formulated as a question to which the "inference engine" (Schulte, 1997; Singh & Karwayun, 2010) can find an answer by making the right deductions based on its rules and initial conditions.

The interconnected problems of the VUCA world require a more complex and adaptive approach, where problems and solutions need to be mutually aligned so that a coordinated strategy for action can emerge. A first generalization we made is to replace production rules by the more general reaction networks (Heylighen, Beigi, & Veloz, 2015). Here a rule is written as a "reaction" between several conditions or resources, e.g.: a + b → c + d + 2e. This allows different resources, produced by different agents, to be combined into more complex products. Moreover, it is possible to specify the rate of reactions so that you can compute the amount of "output" resources produced for a given amount of input resources. That extends the qualitative inferences necessary to describe logical reasoning to the quantitative dynamics necessary to describe economic or ecological processes.

The formalism of Chemical Organization Theory (COT) (Dittrich & Fenizio, 2007; Heylighen et al., 2015; Veloz, Reynaert, Rojas, & Dittrich, 2011) more specifically allows one to determine the conditions under which a network of reactions is self-sustaining. That means that all resources used by the network are produced at least as much as they are consumed. This immediately provides us with a mathematical theory for describing a fully sustainable economy/ecosystem, in which no resource gets exhausted because everything that is not abundantly available (such as sunlight or oxygen) is eventually recycled.

The final step in our generalization is to interpret the conditions and actions—or resources consumed and produced by the reactions—as the "offers" and "needs" of various human, natural or technological agents. A need is a demand for some missing resource; an offer is a resource that is made available under the right conditions. The task of coordination is then to optimally match all needs and offers.
by creating a self-sustaining network of reactions that uses offered resources in order to produce needed resources via some complex of intermediate processes.

As an elementary example, a cattle farm generates manure as a waste product. This waste pollutes rivers if left untended. On the other hand, manure can be used as a fertilizer for growing crops. Coordination can be achieved in this case by interpreting the waste product as an offer coming from the cattle farm. This is then matched with the need for fertilizer coming from a crop farm, after which an exchange is made. Both farms benefit from this exchange. Such a win-win interaction exemplifies the synergy produced by smart coordination between different consumers and producers.

But synergy does not need to be limited to an exchange between two parties: intelligent algorithms can simultaneously coordinate a large number of agents, by searching until they find how a combination of offers can satisfy a combination of needs, while taking into account mutual dependencies and intermediate processes. Such a system for matching offers with needs is what GBI advisor Ben Goertzel introduced under the name of “offer network” (Goertzel, 2015; Heylighen, 2016a, 2016b). Originally, Goertzel conceived an offer network as an intelligent system for supporting economic exchanges. The intention was to allow people to share or exchange goods and services without the need for monetary transactions. But our interpretation in terms of challenges greatly extends its domain of applicability.

We have defined a challenge as any situation that elicits action, because in this situation action produces benefit relative to inaction (Heylighen, 2012, 2014; Weinbaum, 2013). A challenge can be negative, such as a problem, deficiency or unfulfilled need. It can also be positive, such as an opportunity, resource or offer. A challenge can be physical—e.g. a good, product or physical resource that is offered or needed—, social—e.g. a service, collaborator or organization—, or cognitive—e.g. a question, answer, or method. An offer network should be able to represent and match any challenges, whether physical, social or cognitive. It should also be able to aggregate several smaller challenges (e.g. individual people’s need for food) into a larger challenge at a higher level of abstraction (e.g. the problem of hunger in a particular region), which is then matched with another higher level action (e.g. organizing an expedition to bring surplus food to this region), which is itself composed of smaller actions (e.g. collecting donations of food from different individuals).

The formalism of COT is neutral as to the “resources” that are consumed or produced by reactions. Therefore, it can be applied to practically any domain: physical, chemical, biological, ecological, economic, social, political... (Centler, Kaleta, di Fenizio, & Dittrich, 2008; Dittrich & Winter, 2008; Heylighen et al., 2015). This makes it possible in principle to represent and match all challenges experienced anywhere in the world by incorporating them all into one global, intelligent network that can be processed by intelligent algorithms.

The ability to tackle such an interconnected network of challenges is precisely what we would expect from a Global Brain. Building such a universal problem-solving system at the planetary scale will of course require decades of works by thousands of highly skilled people. But we have already formulated a first roadmap towards the realization of this ambitious goal (Heylighen, 2016b). This roadmap lists the steps that can be taken at present and in the foreseeable future, and that are likely to lead towards an increasingly powerful implementation of such a Global Brain. We will now sketch the first steps in this roadmap, as the GBI plans to perform them over the next 5 years, given the appropriate funding.

A Roadmap towards the Global Brain

At its most basic level, an offer network is simply a platform that allows people to formulate what they want and what they are willing to do under which conditions. The first layer of the protocol must therefore provide a language that specifies users, their needs, their offers, and the condition-action rules or reactions that hold between them. This language must be sufficiently explicit so that a computer system can decide without ambiguity whether a particular offer made by one person can satisfy the need of some other person. A prototype of such a protocol has already been developed by the group of our Austrian collaborator Florian
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Kleedorfer (Kleedorfer, Busch, Pichler, & Huemer, 2014), but this does not yet take into account the more complex reactions modelled by COT.

For practical applications, this will need to be complemented by a user-friendly interface in which users can formulate their offers and needs in natural language, after which these are automatically translated into the protocol. In case of ambiguity, the system may ask the users which of several possible interpretations is the correct one, or suggest additional features to be added in order to formulate the need more precisely.

The next step is to formulate one or more algorithms that can match offers and needs indirectly, via a combination of coupled production rules or reactions. This will require the exploration of various existing AI approaches, such as constraint satisfaction or inference engines (Schulte, 1997; Singh & Karwayun, 2010). To extend these approaches to more complex reactions, we will need to further explore and develop the mathematics of COT. This requires implementing a general program for modeling reaction networks and finding the self-sustaining organizations they contain. Algorithms to do this exist, but they will need to be optimized for large-scale networks in order to remain computationally tractable.

COT shows mathematically that large-scale coordination is possible, but we plan to further explore under which precise conditions such “organizations” emerge, and which are the precise features that determine their sustainability and resilience. Mathematical proofs of the existence of good solutions are not yet sufficient: we will also need to show that finding such solutions is computationally feasible. In the worst case, it may turn out that finding optimal solutions is NP-complete, but in practice most NP-complete problems are solved rather satisfactorily (if not optimally) by a combination of heuristic algorithms. Preliminary investigations suggest that such worst case may not be encountered, and that efficient and tractable algorithms for the general program may be found. We are currently investigating a promising approach based on a fractal organization of the resolution process (De Florio, Bakhouya, Coronato, & Di Marzo, 2013).

Another, parallel step in the development of offer networks is to build a prototype that can be tested with a sufficiently large and diverse, but easily manageable, group of users. For example, this could be the community formed by students and personnel of a university or the inhabitants of a city. For such a relatively small-scale prototype, off-the-shelf algorithms should be sufficient to run the system. The experiment will consist in observing in how far the users are willing to express a variety of offers, needs and connecting conditions, how effective the system is in coordinating offers and needs, and how satisfied the users are with the results. The resulting observations should allow us to iron out any unforeseen problems, fine-tune the protocol, algorithms and interface, and demonstrate the feasibility of the general paradigm.

The offer network can be further improved by adding “soft constraints”, i.e. criteria for selecting the best solutions when several offers match a user’s need. These may include efficiency (e.g. selecting the offer that costs least effort to deliver to the one who needs it) and expected quality. The latter will typically depend on the reputation of the resource type, company, or person behind the offer. This will require the development of a general and reliable reputation system, where offers, agents and rules can accumulate rewards or penalties depending on how satisfied the users are with their results. This turns the offer network into a learning system—similar to the one underlying our Challprop model, where links between agents are differentially reinforced depending on the amount of benefit the agents have received by using them (Heylighen et al., 2012; Veitas, 2014). Moreover, a public reputation system will motivate people to make good offers, and not to abuse the system by extracting more than they need (Heylighen, 2016a).

In a yet further stage (which is likely to extend beyond the 5-year horizon of the present proposal), the offer network will need to be coupled to other Internet protocols that are being developed, and that are likely to greatly extend its reach. The Semantic Web is a suite of protocols being developed by the World-Wide Web Consortium headed by Sir Tim Berners-Lee in order to express any kind of knowledge or information in a formal manner, so that it can be interpreted by programs rather than just individuals. This knowledge can in principle also be expressed in terms of condition-action rules, and therefore offer network/COT representations should from the start be interconvertible into semantic web representations. But the practical coupling between the two systems means that the knowledge being formalized in the
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The semantic web will become available for intelligent reasoning within the offer network, thus greatly expanding the scope of the problems that the offer network will be able to solve.

A second coupling that would greatly extend the power of offer networks is with the Internet of Things. This is an emerging infrastructure for the sensing and control of any kind of physical device whose state can be remotely consulted (Atzori, Iera, & Morabito, 2010). This means that objects too will be able to present their offers and needs to the community. For example, a public bicycle could advertise its availability for a ride to anyone who expressed a need for transport in its vicinity, and its needs for repair to any dedicated technician. While the semantic web will spectacularly amplify the cognitive powers of an offer network to reason, answer questions, and provide guidance, the Internet of Things will amplify its physical powers of actually delivering products and services.

In a yet further stage, the offer network protocol should be able to interface with governance and legal systems. This can be achieved by expressing laws, policies, contracts and procedures as condition-action rules: in the following conditions, the following actions should or could be performed. Thus, legal constraints, such as taxes or the prohibition to deliver dangerous goods such as weapons or drugs, and practical procedures can be taken into account while determining the best course of action to satisfy a series of needs. The extra level of trust required for contracts and laws may be secured by emerging technologies, such as the Blockchain underlying Bitcoin. It has been proposed that these may eventually create “Decentralized Autonomous Organizations” (Atzori, 2015; Garrod, 2016) that are held together by dependable, automated contracts that cannot be tampered with because the codes identifying them are fully distributed.

Finally, the offer network should ideally be coupled to the biosphere. This requires modeling the physical, chemical and biological processes that govern the planetary ecosystem in the form of COT reactions that consume and produce certain resources (Heylighen et al., 2015). These “natural” reactions are then added to the “social” and “technological” reactions already present in the network. The network is then analyzed as a whole by the matching algorithms. This ensures that the “offers” and “needs” of the biosphere are duly taken into account, and that the overall system is truly sustainable. The formulation of these planetary-level reactions may be provided by the emerging “Global Systems Science” (Helbing, Bishop, Conte, Lukowicz, & McCarthy, 2012). During our proposed 5-year research project, GBI will already investigate the feasibility of such a coupling with ecosystems and systems of governance. This should allow us to formulate the protocol in such a way that legal and ecological constraints would be easy to incorporate at a later stage, without requiring any fundamental change to the formalism.

Together with the socio-economic self-organization boosted by the offer network’s support for the creation of mutually beneficial relationships, these couplings with technological, semantic, legal and ecological networks should eventually transform the offer network into a true Global Brain, i.e. a nervous system for the planet. Such a system would be able to answer any theoretical questions for which the knowledge is available, while implementing and monitoring practical solutions for all the problems that confront global society (Heylighen, 2015). This is achievable precisely because we start from a conceptual and mathematical theory that does not a priori separate cognitive, physical, social, economic, legal and ecological issues (Heylighen, 2011; Heylighen et al., 2015)—unlike practically any existing theory. Instead, our theory considers all these issues as components of one huge distributed network of interdependent conditions and actions.

Because all conditions and actions are linked through a single medium, this network can in principle self-organize to a balanced configuration in which needs are matched with offers so as to maximize synergy. In practice, this self-organization will need to be supported by a variety of intelligent computer programs that accelerate the search for good matches. Given the tremendous on-going progress in both hardware and software, we have little doubt that such an intelligent global system can be realized over the coming decades.

The present project wants to lay the groundwork for such a development. (A) by developing clear conceptual, mathematical and computational foundations, (B) by formulating and testing the basic elements of a protocol for implementing this strategy, and (C) by demonstrating the feasibility of its various large-scale applications. This should be sufficient to convince others to adopt and extend the protocol and to develop
increasingly powerful technologies to support it. We hope that, once the snowball has started rolling, development will accelerate and broaden, until, in decade or two, the Global Brain has become a reality.

The objective of setting in motion a project that would eventually be able to identify, address and solve world-critical problems at all scales, is of course extremely ambitious. It probably will seem unrealistic to the casual observer, but so are all visionary projects - seeing things that others do not and doing things others think impossible. On the basis of our previous research, we are convinced that the probability of success is real. Even if that probability would be very small or if only a fraction of our aims would be realized, it is still worth investing a substantial amount of funds and effort in this visionary endeavor. It is, after all, the future of humanity and our planet that is at stake, and anything that could significantly increase the chances of a brighter future seems worth supporting. We hope therefore that our sponsor will continue and extend his generous commitment to supporting the realization of this vision, and thus become an active participant in the legacy of the future.

**Research Program**

The above broad vision can be subdivided into three more concrete research scopes, each with a list of interrelated tasks that we plan to address.

**A. Mathematical foundations and computer simulation of coordination**

This part of the research program builds further on our previous theoretical investigations. It intends to elaborate concepts and models into a suite of reliable methods and computer programs for analyzing and coordinating networks of reactions. It will normally include the following tasks:

- Further refine our understanding of self-organization, distributed cognition and open-ended intelligence.
- Elaborate the reaction network formalism conceptually and mathematically.
- Investigate the conditions that make a reaction network self-sustaining and resilient.
- Develop a broad-purpose, user-friendly computer program for creating and analyzing reaction networks.
- Investigate algorithms to find organizations quickly in large networks.
- Implement an extended version of the ChallProp simulation that can be integrated with the COT program.
- Examine the role of learning in the integrated program.
- Build a simulation of offer networks based on the integrated program.
- Revise and fine-tune algorithms based on simulation results.

**B. Development and testing of the offer network protocol**

This scope aims to connect theory to practice, by designing, building and testing an offer network, to be used by an actual community. This is likely to include the following steps:

- Define the formal elements of the protocol: users, offers, needs, reactions, reaction rates...
Design an intuitive interface to help users formulate offers, needs and reactions,
Implement and test algorithm(s) for matching offers and needs,
Integrate these elements in a prototype offer network,
Test the prototype with a real-world community of users,
Ask users to evaluate the effectiveness of recommended solutions,
Revise and fine-tune prototype based on test results,
Formulate soft constraints to refine the recommendations,
Experiment with reputation mechanism to further refine the recommendations,
Inspire other communities to start using the offer network protocol.

C. Investigation of real-world applications

Here we examine how our theoretical and experimental results can be integrated with technological and social developments and challenges in the world at large, so as to make sure that they have a real impact. The present 5-year program is too short to produce a large-scale impact, but our reflections should help us to formulate theory and protocol in such a way that they are ready for an as wide as possible range of critical applications in the subsequent period. These investigations are likely to cover the following issues:

Develop more in-depth scenarios of how offer networks (ON) can help us tackle current challenges (Heylighen, 2016): growing inequality, technological unemployment, universal education, unsustainable use of resources, global warming, lack of democracy, global health, lack of innovation, neglect of non-monetary values,
Develop scenarios for how existing and new sharing platforms/communities/models could be integrated via the offer network protocol into one intelligent Internet,
Investigate the Semantic Web and its potential applications to ON,
Investigate the Internet of Things and its potential applications to ON,
Investigate Decentralized Autonomous Organizations and other methods of distributed governance for their potential applications to ON,
Examine in how far ecosystems can be modelled with COT/ON,
Follow up “Deep Learning” and other recent AI applications,
Follow up implementations of “smart cities” as a model for a “smart planet” (Chourabi et al., 2012),
Investigate patterns of “Global Brain awareness” by analyzing the propagation of challenges across time (Sanli & Lambiotte, 2015),
Make sure that the offer network protocol is ready to interface with all these applications.
2. The GBI institution-building strategy for 2017-2021

Introduction

In order to carry out its ambitious research plan the GBI needs to be able to recruit and retain talented researchers from a broad variety of disciplines and to develop into a solid, smoothly run, scalable organization. This requires achieving the following objectives:

Objective 1. Assure optimal conditions for conducting basic research.


Objective 3. Assure global impact and implementation of the Global Brain protocol.

These are distinct strategic aims, requiring distinct means of execution. The first objective can be pursued independently from the others. Therefore—in case of budget constraints—it is possible to fund only this aspect of the GBI functioning, as was done in the 2012-2016 period. This will result in the development of the different layers of the offer network protocol in the form of a conceptual framework and prototype and in the dissemination of the results via standard academic channels (scientific publication, conferences, social media). However, pursuing the first objective alone is likely to extend the critical dependency of the GBI existence on our primary sponsor, while pursuing the first and second objectives together should achieve the financial self-sustainability of the GBI beyond 2021.

The additional execution of the third objective will require the involvement of other, highly respected organizations, scientists, and public persons—because for a concept to reach the stage of an actual global implementation requires the formation of strategic alliances and the engagement of influential partners. For example, we hope to eventually convince Tim Berners-Lee and his collaborators in the World-Wide Web Consortium to endorse our new protocol. Another potential partner is Jimmy Wales and the Wikipedia community. While we are ready to take the responsibility for coordination of these actions, we realize that this will require a substantial additional financial support from our sponsor (and possibly also a PR and organizational support).

While formulating the three objectives and matching them with appropriate action plans, we have made sure that each such action fits with the three basic research scopes of the GBI, while adding broader “orbits” that would extend the long-term impact of our scientific work. The first orbit is needed to enable the research and to publicize its results via scientific and social media channels. The second orbit will allow the research to become financially self-sustaining. The third orbit will equip us with the means needed to manage its global impact and implementation.

We will now propose action plans, budgets, and evaluation criteria for each of the three objectives.

Objective 1. Assuring optimal organizational conditions for conducting basic research

Theoretical research is best performed in an organizational setting characterized by loose coupling (Weick, 1976) between the various processes and agents, a requisite variety (Ashby, 1956) of competences, ideas and approaches, sufficient autonomy for researchers, and sufficiently long time-spans to allow the exploration, development and testing of new ideas. These requirements, when put into practice, introduce several points
of divergence from even the most flexible project management methodologies (such as Agile, or Scrum). Therefore, when theoretical basic research is pursued in a project-based setting, it is important to develop a project management approach adequate for supporting the creative exploration inherent in scientific work. During the initial five-year period of its existence, the GBI has been experimenting with a variety of project management techniques, until we found some arrangements that appear to work well. For the next five-year period, we want to retain that mode of operation, however, while introducing four novel methods in order to scale up the GBI organization while involving a more diverse array of collaborators:

**Novelty #1. Three semi-independent research scopes.** In order to accelerate the scientific work and to mitigate the risk of aggregation of errors inherent in a traditional top-down chaining between theoretical modelling, prototyping and the real-world implementation, the work will be divided into the 3 scopes (A, B, C) described in the research program. The scopes will be advancing independently, while continuously feeding back into each other.

**Novelty #2. Project management methodology.** By grouping the research into 3 semi-independent scopes, 3 loosely coupled interfaces are created. Each scientific scope will aim at different goals and employ different methods, while generating questions to be answered by the other scopes. While this architecture resembles the “traditional” work-packaging of research projects, we will be gradually transforming it into an COT / Offer Network architecture, where all relations (project → scope, project → challenge, project → person, scope → scope, scope → challenge, scope → person, etc.) will be formulated in a way consistent with the logic of the GB Protocol. Thus, an in-house testing ground will be created for the development of a new project management methodology native to the GB architecture. This result will be an added contribution to the scientific outcomes of the project. Since teams tend to have more impact than individual people, the GB protocol needs to be able to efficiently address the team level by mediating both their external and internal relations. The ideal GB-compatible project management methodology should support a seamless formation, contraction, expansion, transformation, and diffusion of teams, projects, and entire organizations.

**Novelty #3. Distributed leadership.** To perform the double task of coordinating the scientific work within each research scope (as detailed in the GBI research program) and to co-design and test the GB project management methodology, three experienced scientists will be employed as scope leaders. In respect to the project management methodology, the leader of Scope A will be responsible for an ongoing representation of all aspects of the project management in the COT/ON formalism, the leader of Scope B will be prototyping a set of web/mobile-based tools, supporting our project management methodology, and the leader of Scope C will assure that the solution being developed both takes into account and goes beyond state-of-the-art project management. Additionally, the managing director of the project will assure that the resulting methodology is continuously improved and extended to fully accommodate the ambitions of the entire project.

**Novelty #4. Knowledge retention.** The need for the fourth novelty arises from the fact that the scholarship-based employment, used by the GBI so far, allows each person to be employed only for 3 or 4 years, after which the person is no longer eligible for a scholarship. This poses a serious limitation to the accumulation of knowledge in the GBI team, as the complex conceptual framework developed by GBI takes a considerable amount of time to learn before it can be used productively. Therefore, we propose that
scholarship alumni would be retained part-time at the team in a phasing-out manner. This will give them
time to engage in fundraising activities, aimed at the extension of their employment financed by external
sources. The phasing-out period, lasting 2 years, will be broken down into two yearly stages: 1st year, where
the researcher remains employed at 60% time and is responsible for submission of 3 funding proposals, 2nd
year, at 30%, with the task of rewriting and resubmitting of the proposals if they were initially rejected, or of
submitting an additional new one. If not sufficiently funded by then, from the 3rd year onwards, all
scholarship alumni will be invited to participate in the Research Fellowship program (described below as a
part of the GBI Objective 2).

Below follows the budget proposed to be allocated to Objective 1.

**Objective 1. Budget 2017-2021**

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Scope A</th>
<th>Scope B</th>
<th>Scope C</th>
<th>All scopes</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing director</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>€250,200</td>
</tr>
<tr>
<td>Unit: Person-year =€83,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scope leaders</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>€1,251,000</td>
</tr>
<tr>
<td>Unit: Person-year =€83,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-doc (3y) and pre-doc (4y)</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>33</td>
<td>€1,465,200</td>
</tr>
<tr>
<td>scholarships</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€44,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT developers (team based in</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>€320,000</td>
</tr>
<tr>
<td>Ethiopia)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€16,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retained researchers (60% employment</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>€750,600</td>
</tr>
<tr>
<td>, 12m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€50,040</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retained researchers (30% employment</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>€375,300</td>
</tr>
<tr>
<td>, 12m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€25,020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working costs - basic research</td>
<td>26</td>
<td>46</td>
<td>26</td>
<td>101</td>
<td>€606,000</td>
</tr>
<tr>
<td>(conferences, travel, field research,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>visits, publications, equipment, general</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>organization)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =Ave.€6,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VUB overhead(17% of the grant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>€816,456</td>
</tr>
<tr>
<td>TOTAL: objective 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>€4,802,681</td>
</tr>
</tbody>
</table>

Key performance indicators proposed for evaluating the outcomes achieved with respect to
Objective 1 include:

**KPIs, Objective 1. 2017-2021**

<table>
<thead>
<tr>
<th>KPI</th>
<th>Scope</th>
<th>Indicator</th>
<th>Measure</th>
<th>2016</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>A</td>
<td>The COT modelling tool (for</td>
<td>A documented software</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>B</td>
<td>Software components of the GB protocol for matching offers and demands (for developers)</td>
<td>A documented software package made available for free downloading at the GBI website</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1.3</td>
<td>B</td>
<td>Software components of the GB protocol for agents’ reputation tracking (for developers)</td>
<td>A documented software package made available for free downloading at the GBI website</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1.4</td>
<td>C</td>
<td>The GB scenarios papers, introducing the vision of the GB Protocol into a selection of domains (e.g. sustainability, smart cities, crisis management, project management, entrepreneurship, quality of life, etc.)</td>
<td>Number of scenario papers published by high profile domain-appropriate journals</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>1.5</td>
<td>A,B,C</td>
<td>Published papers</td>
<td>Number of GBI-affiliated papers published in international scientific journals – accumulative since 2012</td>
<td>36</td>
<td>120</td>
</tr>
<tr>
<td>1.6</td>
<td>A,B,C</td>
<td>Working papers</td>
<td>Number of GBI-affiliated unpublished papers made available at the GBI website during the last calendar year</td>
<td>13</td>
<td>45</td>
</tr>
<tr>
<td>1.7</td>
<td>A,B,C</td>
<td>Seminars</td>
<td>Number of GBI seminars available online – accumulative since 2012</td>
<td>93</td>
<td>200</td>
</tr>
<tr>
<td>1.8</td>
<td>A,B,C</td>
<td>Seminars popularity</td>
<td>Number of views of the GBI seminars on Youtube during the last calendar year</td>
<td>20,150</td>
<td>60,000</td>
</tr>
<tr>
<td>1.9</td>
<td>A</td>
<td>All project management processes encoded into the COT/ON formalism</td>
<td>Encoded input for the development of the online project management tool</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1.10</td>
<td>B</td>
<td>The online tool for project management</td>
<td>A documented software package made available for free downloading at the GBI website</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1.11</td>
<td>C</td>
<td>The scientific background for the project management methodology</td>
<td>A paper published by a high profile project management journal</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>1.12</td>
<td>C</td>
<td>The operational manual for the GB-P-based project management</td>
<td>A GB-P-based project management manual made available for free downloading at the GBI website</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>
Objective 2. Assuring future financial sustainability of the GBI beyond 2021

Basic and theoretical research rarely generates financial returns for the organization at which it is being conducted. Such organizations therefore tend to rely on public funding, often combining research with higher education. Since it takes years of lobbying and administrative effort to establish a new publicly sustained organization, ambitious theorists typically do not invest their time in creating new organizations, but tend to join reputable existing ones. On the other hand, research groups that start a new research unit without access to continuous public financing tend to eventually drift away from long-term basic research, while becoming increasingly occupied with the development of short-term marketable outcomes. Given the above limitations, we do not believe that turning the small GBI organization into a hybrid between the long-term scientific and the short-term “academic entrepreneurship” types of activities would be a good strategy. Therefore, we propose a different strategy, aimed at making GBI continuously sustained by public funding. Our action plan targets two sources of such financing:

1. Different research funding grants offered by public sector bodies, such as the European Commission, the Flemish Research Foundation and other national or international funding schemes — by 2020 we plan to have at least 4 multi-year projects (avg. €1 million each) run simultaneously at any given time.

2. Continuous public funding associated with delivering higher education programs within the Flemish system of higher education — by 2020 we plan to announce the first recruitment of students for 1 Master’s program, 3 “Advanced Master” programs, and 1 PhD research school.

Attainment of these aims by 2020 is realistic, and possible to be interwoven into the basic scientific efforts of the team, providing that we adopt and execute a deliberate strategy, coupled with a specifically structured budget. Below follows the explanation of our 2017-2021 action plan towards these two particular outcomes.

Research funding grants. For the GBI to rely continuously on grant-based funding, our strategy must address several objective challenges related to the development and submission of research funding proposals—in particular the very low success rate (of the order of 5%) and very high administrative overhead of traditional proposal submission schemes (see appendix). We have devised a coherent strategy for dealing with these challenges: we plan to launch a large-scale “GBI Fellow” program, which recruits Fellows while requiring them to submit a large number of grant proposals in parallel. Fellows will be selected based on the prior training, certification, and examination of candidates via three Massive Open Online Courses (MOOCs) that we will offer for free to any student in the world: (1) “Principia Cybernetica” as a broad, theoretical foundation, (2) “Evolution, Complexity and Cognition” as a more concrete system of concepts and methods for dealing with complex, intelligent systems, and (3) “Global Brain: the future of the Internet” as a survey of the different technologies and social developments necessary to understand the emerging GB. Nominations to the GBI Research Fellows program will be offered to top ranking alumni of this entire 3-course research training track. Recruited Fellows will be offered a yearly 10%, 20%, or 30% employment at the GBI with the task of preparing and submitting 1, 2, or 3 proposals per year, respectively. Based on the general success rate in the European Commission’s calls, we assume that by submitting 50 proposals per year (on average) we may expect that every year we will obtain funding for at least 2 new multiyear projects. This strategy has been detailed in the Appendix to this document.
**Higher education programs.** By 2020 we plan to announce the first recruitment of students for 1 publicly sponsored Master’s program, 3 tuition-based “Advanced Master” programs, and 1 publicly sponsored PhD research school. All these programs will constitute a broadly formulated “Global Brain Studies” educational curriculum, in which future entrepreneurs, technology developers, policy makers, and social activists will learn to put the concepts and technologies of the Global Brain into practice. While the advantages of MOOCs over traditional educational programs are obvious and many, it is still the traditional forms of higher education that make scientific institutions eligible for continuous public funding. Therefore, even if in terms of outreach and impact the investment in MOOCs is better justified, from the financial perspective, an additional investment into transformation of MOOCs into a traditional, degree-granting university program is needed to generate a stable revenue stream. Fortunately, most of the work related to curriculum development can be done simultaneously for both the MOOCs and traditional programs. The remaining tasks to be financed are (1) to formulate the curriculum as a gateway to an attractive degree with an inspiring job market outlook and (2) to administratively and “politically” navigate the process of establishing new curricula within the context of the intra-university and governmental regulations. Both tasks can be performed by a higher education administrator with an experience in establishing new educational programs at a Flemish university.

Below follows the budget requested for carrying out Objective 2:

**Objective 2. Budget 2017-2021**

<table>
<thead>
<tr>
<th>Cost category</th>
<th>All scopes</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GBI Research Fellow program</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: 10% Person-year =€8,400</td>
<td>250</td>
<td>€2,100,000</td>
</tr>
<tr>
<td><strong>GBI Research Fellow program coordinator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€61,200</td>
<td>5</td>
<td>€306,000</td>
</tr>
<tr>
<td><strong>MOOCs teaching assistants: PCP, ECCO, GB (PhD students)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€55,500</td>
<td>15</td>
<td>€666,000</td>
</tr>
<tr>
<td><strong>HE programs coordinator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit: Person-year =€83,520</td>
<td>5</td>
<td>€417,600</td>
</tr>
<tr>
<td><strong>Working costs - fundraising</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Fellows’ conference costs, travel, field research, visits, publications, equipment, marketing of the educational offers, general organization)</td>
<td>275</td>
<td>€1,650,000</td>
</tr>
<tr>
<td>Unit: Person-year =Ave. €6,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VUB overhead (17% of the grant)</strong></td>
<td></td>
<td>€1,052,689</td>
</tr>
<tr>
<td><strong>TOTAL: objective 2</strong></td>
<td></td>
<td>€6,192,289</td>
</tr>
</tbody>
</table>

KPIs proposed for evaluating the outcomes achieved in respect to the Objective 2 include:

**KPIs, Objective 2. 2017-2021**

<table>
<thead>
<tr>
<th>KPI</th>
<th>Scope</th>
<th>Indicator</th>
<th>Measure</th>
<th>2016</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>A, B, C</td>
<td>Research funding proposals</td>
<td>Number of research funding proposals submitted or resubmitted on behalf of the GBI - accumulative since 2012</td>
<td>6</td>
<td>206</td>
</tr>
</tbody>
</table>
### Objective 3. Assuring global impact and implementation of the research results

All scientific outputs of our research plan are intended to produce a global impact and implementation. The results will be published in high-profile international journals, presented at international conferences and broadcasted via the GBI social media channels, while the software components developed in the project will be open-sourced and made freely available online. The action plan supporting the above two organizational objectives has been designed to reinforce this global impact. The GBI Research Fellows program admitting 17-50 international Fellows yearly, the 3 free biannually repeated MOOCs and the 5 higher education programs will all significantly expand and strengthen the global network of GB supporters, theorists, developers, and implementers.

However, the impact achieved in this way is still difficult to predict and control. While the global spread of the GB protocol will be a process of self-organization, we are well aware that the earliest stages of such a process are the most critical and fragile. For example, the way in which the GB protocol will be understood and implemented by its first 100 independently acting early adopters will have incomparably greater impact on the further trajectory of its development than that of any other 100 adopters who join later.

Therefore, it seems advisable to extend our project with a set of additional actions that would support the further implementation and development of the GB protocol by a selected number of high-profile scientific groups (e.g. at MIT, Oxford, W3C...), technology development teams and Internet startups. Their projects, developed independently in response to our calls for proposals, would be scientifically guided and overseen by the GBI, while being financially supported directly by the Milner Foundation.
Below we outline four actions likely to have a great impact, focused on specific challenges identified in our program. We leave it up to our sponsor to choose among them and to decide on the budgets that could potentially be allocated to each:

**Action #1. Projects to integrate offer networks with the Semantic Web.** An open competition-based call for proposals, aiming to develop protocols to convert the offer network/COT representations into semantic web representations and vice versa. A selection of seedling grants (€500k – 1 mln) could be allocated to 10-20 teams of developers in order to create a diverse pool of competing approaches and architectures.

**Action #2. Projects to integrate offer networks with the Internet of Things.** An open competition-based call for small project proposals, addressed to a large number of developers of the Internet of Things technologies (e.g. 100-200 small tech companies). Each participant would be awarded a small grant (€10k - 50k) for the integration of one specific technology into the offer network.

**Action #3. Projects to integrate offer networks with the basic legal regulatory frameworks.** An open competition-based call for proposals, aiming to interface offer networks with governance and legal systems in order to mitigate the risk of the offer network architecture being rejected by these systems. Several seedling grants (€500k - 1 mln) could be allocated to 3-5 research institutions, with the aim of representing an initial selection of legal frameworks (tax, trade, labor, commercial) as offer network’s condition-action rules.

**Action #4. Projects to integrate offer networks with the planetary ecosystem.** An open competition-based call for proposals, aiming to develop representations of physical, chemical and biological reactions that govern the ecosystems, which are most critically coupled with socio-economical systems. A selection of seedling grants (€500k - 1 mln) could be allocated to 5-10 research institutions (e.g. leaders of the Global Systems Science), who are most advanced in modelling of the interdependencies between ecosystems and socio-economical systems.
3. Proposed budget summary

**GBI, 2017-2021 (Objectives 1 & 2)**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Personnel costs (GBI + Fellows)</th>
<th>Working costs (GBI + Fellows)</th>
<th>VUB overhead</th>
<th>Grants for partners</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1</td>
<td>€3,380,225</td>
<td>€606,000</td>
<td>€816,456</td>
<td>€0</td>
<td>€4,802,681</td>
</tr>
<tr>
<td>Objective 2</td>
<td>€3,489,600</td>
<td>€1,650,000</td>
<td>€1,052,689</td>
<td>€0</td>
<td>€6,192,289</td>
</tr>
<tr>
<td>Objectives 1&amp;2</td>
<td>€6,869,825</td>
<td>€2,256,000</td>
<td>€1,869,145</td>
<td>€0</td>
<td>€10,994,970</td>
</tr>
</tbody>
</table>

**The modular extensions (Objective 3)**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Personnel costs (1 GBI coordinator for each action)</th>
<th>Working costs (GBI)</th>
<th>VUB overhead</th>
<th>Grants for partners</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obj. 3. Action #1</td>
<td>€417,600</td>
<td>€150,000</td>
<td>€1,162,255</td>
<td>T.B.D.</td>
<td>T.B.D. +€567,716</td>
</tr>
<tr>
<td>Obj. 3. Action #2</td>
<td>€417,600</td>
<td>€150,000</td>
<td>€1,162,255</td>
<td>T.B.D.</td>
<td>T.B.D. +€567,716</td>
</tr>
<tr>
<td>Obj. 3. Action #3</td>
<td>€417,600</td>
<td>€150,000</td>
<td>€1,162,255</td>
<td>T.B.D.</td>
<td>T.B.D. +€567,716</td>
</tr>
<tr>
<td>Obj. 3. Action #4</td>
<td>€417,600</td>
<td>€150,000</td>
<td>€1,162,255</td>
<td>T.B.D.</td>
<td>T.B.D. +€567,716</td>
</tr>
<tr>
<td>Objective 3</td>
<td>€1,670,400</td>
<td>€600,000</td>
<td>€465,022</td>
<td>T.B.D.</td>
<td>T.B.D. +€2,270,865</td>
</tr>
</tbody>
</table>
Appendix

GBI fundraising strategy, 2017-2021

Challenge #1: Statistics
Publicly announced calls for research proposals typically attract many competitors whose numbers drastically exceed the capacity of the allocated budgets. As a result, the success rate (i.e., the statistical chance of a proposal being funded) in European competitions typically falls below 5-6% and in the most prestigious competitions (like the European “Future and Emerging Technologies”) gets as low as 1%. From the perspective of an individual researcher this statistic is highly discouraging: while preparation of one good proposal consumes about 2-3 months of high-quality work, intense networking, and creative cooperation, it is matched with a 94-99% chance of failure. On the other hand, at the organizational level, “grant-raising” strategies tend to work, providing that they are based on statistically realistic assumptions: if an average research institution is capable of orchestrating the submission of 100 proposals, it is highly likely to have at least 5 projects funded. Additionally, the large number of proposals coming out of one institution amounts to a large experience base, which can be used to feed an internal learning process, aimed at the steady increase of the initial yearly success rate.

Solution: To assure that by 2020 the GBI has at least 4 multi-year projects running simultaneously at any given time, will require, on average, contracting 2 new projects per year. This means submitting 50 research proposals per year and use that as an initial base towards the continuous improvement in effectiveness. This does not mean that all 50 proposals must be original, as the life cycle of one failed proposal typically extends to 2–3 iterated versions, submitted to different competitions.

Challenge #2: Creative waste
The fact that the above strategy will be effective on the aggregate organizational level does not automatically warrant its workability at the individual level; from the perspective of an individual researcher the investment of time and energy into the preparation of a single proposal will most likely still be wasted. However, since the shadowing of valuable outputs by needless waste is a general trademark of the current global economy—and one which the GB protocol should easily do away with!—production of waste at the micro-scale should be dealt with by the same mechanism, implemented at the project management level. This leads to the conclusion that the “grant-raising” activity of the GBI, a typical situation based on a “genetic algorithm” logic, in which many creative ideas and projects are formulated but only a fraction of them is getting selected, will open up yet another valuable in-house testing ground for the development of our GB-compatible project management methodology.

Solution #2: A tentative solution (apparent already at this stage of its development and subject to further evolution) is that all failed projects should be decomposed into smaller units (e.g. units of original writing and “work-packaged” research plans) and introduced by their authors into the internal “offer network”, to be included as parts in co-authored publications or in other funding proposals. This way, the body of knowledge aggregated by each GBI scientific scope will be extended by a large pool of case studies and scenarios, demonstrating usability and implementability of the COT, ON, and GB-P concepts and architectures in a multitude of contexts. Such granulation of creative outputs coupled with the offer network as a mechanism supporting their inter-connectivity should eventually eliminate waste of time and energy spent on the unsuccessful proposals, giving their authors further opportunities for their work to be utilized towards the ultimate outcomes of their choice.

Challenge #3: Motivation
Another challenge arises from the role and place of fundraising activities in the standard academic career. Unlike entrepreneurs, the majority of successful academics do not perceive this activity as interesting: they tend to resort to it only to the extent that it is necessary for having their own employment and research costs funded. For that reason, the core full-time team members of the GBI will not be expected to divide their time between research and proposal writing. The “phasing out” stage of their employment will introduce this option at the moment in their career when they will be motivated to get engaged in it anyway. In order to
have a large number of researchers engaged in the GBI “grant-raising” activity, this activity must be targeted at scholars whose job situation demands such engagement: prospective post-docs, researchers on expiring contracts, researchers interested in mobility...

Solution #3: To orchestrate 50 GBI-affiliated proposals being submitted or resubmitted every year by such profiled researchers, we will launch a GBI Research Fellow program, in which researchers who are interested in joining the GBI team will be offered a yearly 10%, 20%, or 30% employment at the VUB (while still based elsewhere) in exchange for preparation and submission or resubmission of 1, 2, or 3 proposals per year, respectively. In terms of motivation to develop funding proposals, this form of affiliation appears to strike a balance between creating a sense of job-like affiliation and obligation and out-of-job motivation to fundraise. Supported by the creative “waste” recycling method, the program will result in building a synergistic extension “around” the three GBI research scopes: each scope will be joined by a number of external but closely affiliated collaborators, who will be contributing their ideas, research plans, and writings and will propagate the GBI research outputs across their own social and professional networks.

Challenge #4: Conceptual onboarding
The final important constraint to address is the substantial time that will be needed for the GBI Research Fellows to sufficiently learn our paradigm. To develop projects that not only apply what has been achieved so far, but actually advance the GBI research, new Fellows will need a thorough understanding of the GB paradigm: its foundations, state of the art, and emerging challenges. So far, it has been taking at least one year of full immersion for a new GBI team member to become sufficiently fluent in the conceptual framework that underpins our GB research.

Solution #4: Since we expect the new GBI Research Fellows program to immediately start generating good quality projects, the “conceptual onboarding” of the Fellows (confirmed by an exam-based demonstration of the achieved fluency) should occur before their admission to the program. To that end, we will make the entire GBI scientific framework available for self-training and self-testing in the form of 3 freely available Massive Open Online Courses (MOOCs): (1) “Principia Cybernetica” as the theoretical foundation, (2) “Evolution, Complexity and Cognition” as the conceptual framework, and (3) “Global Brain: the future of the Internet” as the introduction to navigating within the three overlapping formal architectures of the GB Challenge Propagation, Chemical Organization, and Offer Networks. Starting from 2018, when all courses will become available online, nominations to the GBI Research Fellows program will be offered to top ranking alumni of this entire 3-course research training track. Naturally, the result will reach far beyond the fact that the Fellows program will become indeed capable of generating good funding proposal. Simultaneously, will gain an additional powerful channel for propagation of our research and we will develop a reliable means for talent acquisition.
References


