Using Models to Capture Patterns for Radically Increasing Social Impact

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Abstract
General Collective Intelligence is an emerging science that creates the possibility of exponentially increasing our general problem-solving ability and therefore our ability to solve any problem in general. This translates into significantly increasing social impact. One way of achieving this is defining patterns through which projects might be combined into networks of cooperation that increase impact on collectively targeted goals. In the case of the sustainable development goals, there are three patterns that together can be demonstrated to represent an exponentially greater number of potential solutions than currently available, and which can be demonstrated to have the potential for this exponentially greater impact. All of these patterns can be represented through domain specific models. This paper explores those models and how they might be leveraged to achieve this radically increased social impact.

Keywords:
Model-Driven Engineering for Social Good; Human-Centric Functional Modeling, General Collective Intelligence

Introduction

In model-driven architecture or engineering, applying patterns of solutions refers to the process of creating a model of an abstract pattern of solution, and/or one or more implementations of the pattern, and then inserting that abstract pattern into the solution model, and potentially inserting one of those implementations into the solution itself where the pattern is called for. Aside from potentially some specialized cases of model-driven engineering, models of patterns are normally applied manually.

However, the functional state spaces used to model systems in a General Collective Intelligence are complete semantic representations in which every pattern is predicted to be machine searchable, so that defining models in functional state space turns models into patterns that can potentially be searched for, discovered, and applied automatically when implementations of those models in software exist. These complete semantic representations are predicted to enable complete round-trip model-driven engineering in which software code is generated from models, and models can be generated from software code.

This paper describes a set of three patterns that might be modeled and used to radically increase social impact. There is a natural progression from ontologies that approximate functional state space, to representing a subset of patterns in functional state space, to representing a set of basic functions that "span" the entire functional state space in being able to represent any pattern whatsoever, to defining a number of interacting functional state spaces which represent the behavior of systems in a hierarchy of different domains that are part of a larger composite system. These eventual functional state space based domain models differ from other domain models in that domains are constrained to be defined by all the operations acting on a particular domain object rather than being defined by any logic that might be arbitrary. They also differ in that the functional approach makes it possible to observe what the system functions to achieve as well as to understand the interaction between those functions without having to understand how the system implements those functions. In the case of cognition for example, it allows the functions of cognition to be modeled and deep insights to be gained about the system

without having to understand anything whatsoever about how those functions are implemented in terms of neurons or other structures.

A General Collective Intelligence or GCI [1] is a hypothetical platform that organizes groups in a way that is predicted to create the capacity to exponentially increase the general problem-solving ability of the group, or ability to solve any problem in general, where this group problem-solving ability has been hypothesized to be measured by a general collective intelligence factor (c) [2]. When applied to social impact, the collectively intelligent cooperation possible through General Collective Intelligence is predicted to be the greatest potential source of impact on every social problem, since an exponential increase in the magnitude of this impact is not predicted to be reliably achievable by any other means of computing, even one as powerful as quantum computing when the technology is finally perfected, because creativity in the use of these tools face the bottleneck of a single human mind. That is, all of these tools have narrow problem-solving ability, and must face the bottleneck of a single human cognition when insights from a solution discovered in one area using these tools has to be generalized to create insights in another.

Furthermore, because GCI creates the potential to achieve impact in a financially self-sustaining way, impact can potentially be scaled to transform communities globally, creating the potential of increasing impact to the point that wicked challenges like poverty and climate change are predicted to become reliably solvable. Since this has not yet been achievable by any other means, GCI might be the most important direction of research in the world today for all aspects of social impact. GCI not only creates opportunities for scaling cooperation, it also removes barriers to it. Without GCI there are specific categories of problems in social impact that it is predicted simply can't currently be solved because of various cognitive biases that make groups unable to reliably make better decisions regardless of the amount of research performed, or the amount of discussion or information shared [3]. Although a complete GCI has not yet been implemented, analysis of designs for platforms approximating a subset of GCI have confirmed the potential capacity for this exponential increase in social impact [4].

In orchestrating problem-solving related to systems, GCI relies on an approach towards systems modeling that is “human-centric” and therefore hypothesized to be universal, so that all individuals who understand a given problem domain might be able to leverage that model using natural language, without need to learn any specialized technical language. This approach towards systems modeling is also “functional” rather than “factual” since it relies on describing what a system can be observed as functioning to achieve, rather than relying on describing a system from the perspective of assuming any given set of claims (facts) are true. A silly but very useful example of the difference is describing the property of size by how many angels can dance on the head of a pin according to the prevailing set of claims on the matter, without having proof of any of them, as opposed to describing size according to some function such as what volume of an incompressible fluid an object of a given size might displace. This “Human-Centric Functional Modeling” is relevant to model driven engineering because one of the ways such universal models create the potential for radically increasing collective impact on any common problems is through creating the potential to radically increase reuse of models and their implementations.

Three Patterns for Radically Increasing Social Impact

In the first of three patterns, hypothesized to have the potential to radically increase social impact, a group of businesses cooperate within a “collectively intelligent value chain” to achieve significantly increased impact on some common goal. Each business not at the end of the middle of the value chain agrees to purchase some key product or service from another business in the value chain, in return for another business agreeing to purchase a key product or service from it. All businesses in the value chain

cooperate to subsidize a key product at the end of the value chain in order to reliably out-compete imports in order to ensure demand for local products. This cooperation is collectively intelligent because it can radically increase outcomes for all participants. As described in table 1, this has been called the "Chains of Cooperation" pattern.

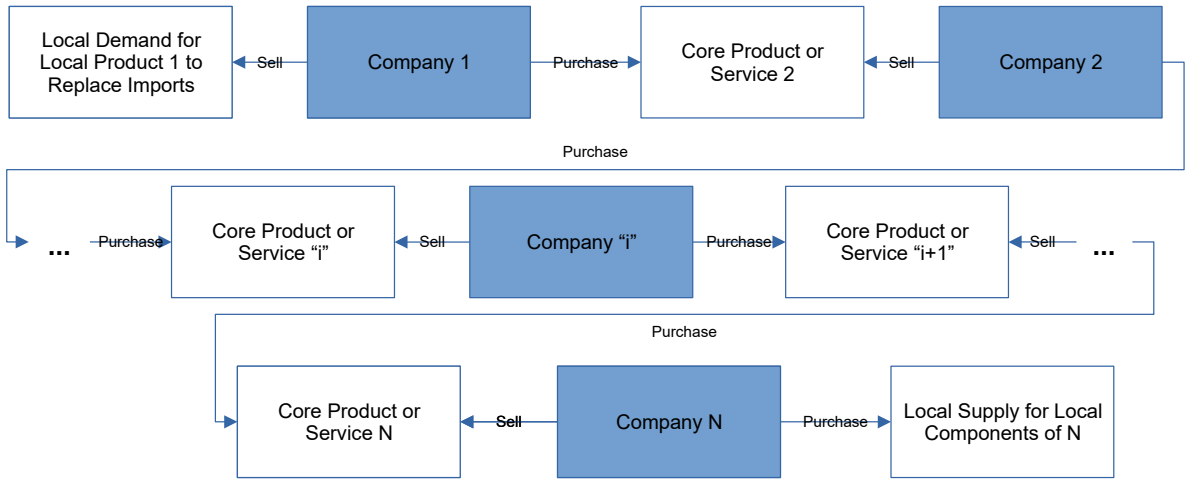

Figure 1: *The Collectively Intelligent Value Chain.*

As a specific example of this "Chains of Cooperation" pattern, the conceptual case study of a school uniform value chain in South Sudan showed the potential to increase collective outcomes (impact on agricultural livelihoods) by seven hundred and fifty times per program dollar [5]. All three patterns are described in table 1.

Patterns in the Use of Human-Centric Functional Modeling and General Collective Intelligence to Increase Social Impact

Pattern	Name	Description
1	"Chains of Cooperation" (also called "Value Chains" in a business context)	Increasing Impact on Collective Outcomes through Deployment of Collectively Intelligent Chains of Cooperation (Solve Closed Problem with Closed Solution, that is, No New Products or Services) [5]
2	"Change of Components in Cooperation" (also called "Engineering New Products or Services" in a business context)	Increasing Impact on Collective Outcomes through Development of New Collective Intelligence Based Products and Services Deployed in Collectively Intelligent Chains of Cooperation (Engineer New Products and/or Services as an Open Solution to Solve a Closed Problem) [6]
3	"Change of Targeted Outcome and Components of Cooperation" (also called "Incorporating Research into the Engineering of New Products or Services" in a business context)	Increasing Impact on the SDGs through Collective Intelligence Based Research of New Technologies Incorporated in the Development of New Collective Intelligence Based Products and Services Deployed in Collectively Chains of Cooperation (Research New Technologies and Engineer New Products and/or Services as an Open Solution to Solve an Open Problem) [7]

Table 1: *Patterns in the Use of Human-Centric Functional Modeling and General Collective Intelligence to Increase the Societal Impact of STEM*

As a specific example of the "Change of Components in Cooperation" pattern, the conceptual case study of a healthcare value chain in the US showed the potential to increase collective outcomes (impact on access to affordable healthcare) by up to 40% through development of GCI based healthcare and health insurance platforms [6]. As a specific example of the "Change of Targeted Outcome and Components of Cooperation" pattern, the conceptual case study of a "Design for Change – Nairobi" sustainable housing design challenged showed the potential for an increase collective in outcomes (impact on access to affordable sustainable housing) by a significant enough margin to impact poverty [7]. This impact on sustainable housing is expected to occur through research into semantic representation of designs, where that research might be incorporated into a "Collaborative Design Platform" which facilitates collaboration between a massively larger number of designers to discover higher impact outcomes in a far larger region of solution design space [7].

Any information that can be conceived, has some representation in conceptual space. Representing each part of the collectively intelligent value chain in terms of the basic functions of the conceptual space is too abstract to be useful, and attempting to represent each part of each collectively intelligent value chain in each industry, sector, or each other categories by which they might be subdivided, results in too many activities with too many descriptions to make it easy to find useful commonality. However, defining a domain specific model within the conceptual space to represent key properties of this "collectively intelligent value chain" pattern, where all instances of that pattern fit into the model, can help a wide range of software platforms manipulate the model to achieve vastly greater social good. In this model, businesses in the collectively intelligent value chain purchase or sell products or services in the value chain. Entrepreneurs, donors, investors, and other potential participants bid for roles. Finance or investment to go instances of each business model in the value chain, and agreements are entered into and the terms of those agreements are executed. The objects, actions, and roles in this model are shown in figure 2.

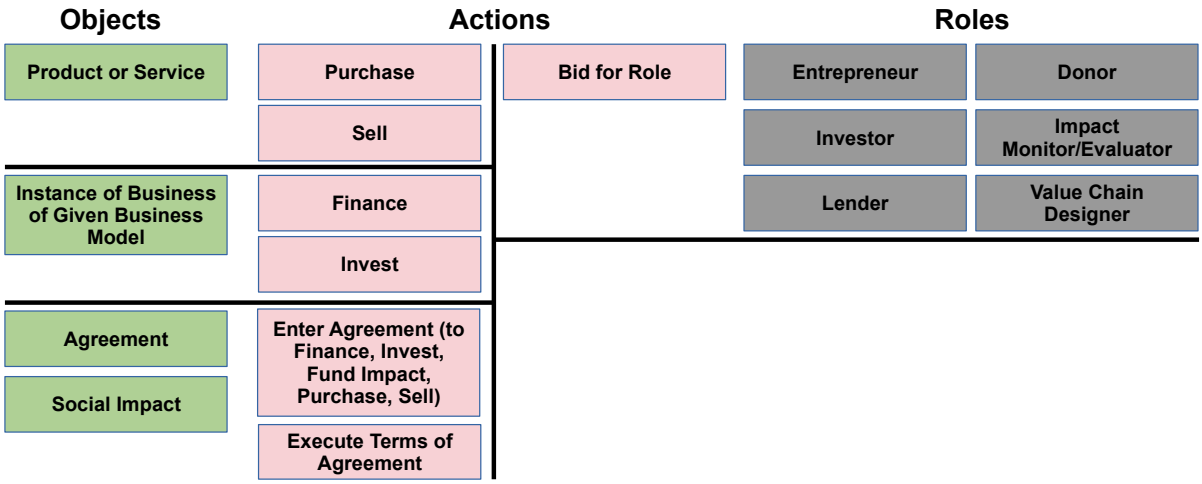

Figure 2: *Roles, Objects, and Actions in the Collectively Intelligent Value Chain.*

In Human-Centric Functional Modeling a domain of functionality is defined by a single domain object that all actions within that domain receive as input and/or produce as output. Using model driven engineering results in a different modeling framework for each such domain. In figure 2 the objects and roles serve as domain objects and the actions are the processes by which the system described by each model transitions between states in that domain.

As an example of how such models might be applied, the proposed “Social Impact Marketplace” platform might automate the discovery and launch of value chains (pattern 1), or it might automate the discovery of new products or services that might be developed and launched through such value chains (pattern 2), or it might automate the discovery of new technologies that might be researched and then incorporated into new products or services that might be developed and launched through such value chains (pattern 3). Therefore, this platform might make use of the ontology, and therefore make use of the underlying model, for all three of these patterns by which social impact might be increased.

Other platforms, such as the proposed “Discrete Distributed Work Management Methodology (DDWMM)” might be used to manage the processes in such value chains. All such platforms might leverage the same three patterns for increasing impact. The goal with such a model is significantly increased reuse.

The first three phases of a ten phase hypothetical Collective Intelligence based Program to Accelerate Achievement of the Sustainable Development Goals (CIPAA-SDGs) provide examples of these potential impacts on a range of outcomes (table 2):

CIPAA-SDGs Program		
Phase	**Description**	**Targeted Outcome**
I	Increasing Impact on the SDGs through Deployment of Collectively Intelligent Value Chains (Pattern 1: No New Products or Services)	Increased Agricultural Livelihoods
II	Further Increasing Impact on the SDGs through Development of New Collective Intelligence Based Products and Services Deployed in Collectively Intelligent Value Chains (Pattern 2: Engineering New Products and/or Services)	Increased Access to Employment as well as to Affordable Education, Healthcare, Renewable Energy, Food Security, Water and Sanitation
III	Still Further Increasing Impact on the SDGs through Collective Intelligence Based Research of New Technologies Incorporated in the Development of New Collective Intelligence Based Products and Services Deployed in Collectively Intelligent Value Chains (Pattern 3: Research New Technologies)	Increased Access to Affordable Sustainable Housing

Table 2: *Targeted outcomes of the CIPAA-SDGs Program per phase.*

Problems Requiring these Patterns

Some patterns of problems [3] that are not believed to be solvable with other current decision-systems, and therefore without this modeling are:

- The "famine problem" (misaligned incentives).
- The "better mousetrap problem" (inability to compare options and reliably select best one).
- The "directions problem" (inability to discern which research direction provides the most productive path forward in the case of wicked problems).

In exploring the three patterns (pattern 1: defining GCI based value chains, pattern 2: engineering GCI based products or services, pattern 3: GCI based research) for massively increasing capacity to address these problems and massively increasing the societal impact of STEM, future research might explore how those patterns might be constructed entirely from proven business management patterns (cross subsidization, economy of scale, value chain redundancy for resilience, service level optimization, etc.) for which there are many case studies in the literature demonstrating their validity.

Extending the Patterns towards Accelerating Impact in Other Disciplines
In essence, the three patterns simply facilitate the exploration of a far larger region of thought (a far larger region of conceptual space and the concepts it contains as well as the reasoning connecting those concepts). These patterns can be abstracted so that they apply to all concepts as in table 3, then also applying to the basic sciences and not just social impact.

Patterns in the Use of Human-Centric Functional Modeling and General Collective Intelligence to Increase the Societal Impact of STEM	
Name	**Description**
"Chains of Cooperative Reasoning"	Cooperation to Execute Collectively Intelligent Chains of Reasoning (Solve Closed Problem with Closed Solution, that is, No New Concepts)
"Change of Concepts in Cooperation"	Increasing Impact on Collective Outcomes through Development of New Instances of Existing Concepts Deployed in Cooperation to Execute Collectively Intelligent Chains of Reasoning (Develop New Instances of Existing Concepts as an Open Solution to Solve a Closed Problem)
"Incorporating Research into the Development of New Instances of Existing Concepts"	Further Increasing Impact on Collective Outcomes through Research of New Concepts Incorporated in the Development of New Instances of Existing Concepts Deployed in Cooperation to Execute Collectively Intelligent Chains of Reasoning (Research New Concepts and Develop New Instances of Existing Concepts as an Open Solution to Solve an Open Problem)

Table 3: *Patterns in the Use of Human-Centric Functional Modeling and General Collective Intelligence to Increase the Societal Impact of STEM*

The idea of an infinitely divisible functional state space implies the capacity to divide a conceptual space into as many different regions as required to divide problem-solving between N individuals, and to coordinate that problem-solving so there is no overlap.

Direction Forward
In the past year a number of academic papers have been accepted for publication or have already been published by peer reviewed articles in this new field. However, because this research topic is so new, some guidance forward must be provided before researchers can have enough background to submit papers. This paper is intended to provide some insight on how these concepts can be applied to each researchers own work in the area of modeling for social good, in order to create the capacity to radically increase that beneficial social impact.

One of the most important elements of the path forward is conducting research into how Human-Centric Functional Modeling might be used to model problems in mathematics and a wide range of scientific and other disciplines (physics, biology, psychology, computer science, engineering, systems modeling, and sustainable development), so these problems in each domain can be represented in terms of a functional state space that allows problems in that domain to be solved by collective reasoning processes executed by a GCI [8]. A planned set of Large Scale international Collaborative REsearch (LSCORE) initiatives has been designed to achieve this modeling (table 4), where the LSCORE initiatives themselves might leverage GCI to scale their performance across any arbitrarily large number of researchers.

Proposed LSCORE Initiatives

Topic	Description	Targeted Outcome
General Collective Intelligence and the Sustainable Development Goals Williams	Explore how GCI can be applied directly as well as through the three patterns within sustainability and sustainable development.	Increased Impact on the SDGs
The Science of General Collective Intelligence	Explore how GCI can be applied directly as well as through the three patterns within the life cycle of any technology from design to recycling.	Increased Impact on Outcomes Related to Technology
A Human-Centric Functional Modeling Framework for Defining and Comparing Models of Biological Systems Including Consciousness and Cognition	Explore how GCI can be applied directly as well as through the three patterns within the biological sciences.	Increased Impact on All Biological Sciences
General Collective Intelligence and the Physics and Mathematics of Life	Explore how GCI can be applied directly as well as through the three patterns within mathematics and the basic sciences.	Increased Impact on All Physical Sciences

Table 4: *Targeted outcomes of the LSCORE Initiatives.*

Conclusions

The purpose of this short conceptual paper is to create mind share and to stimulate further discussion. Unlike most projects with the potential for massively transformative impact, launching GCI eventually might not even require money. When sufficient mind share for the idea is created, it's predicted that GCI will be able to self-start and drive the massive change it is hypothesized to have the capacity for.

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