Sub-themes:
- 5.3. Reforming Public Research Organizations to cope with the innovation challenge: instruments, models, experiences
- 14.3. Innovation journalism: crossing borders between business, technology and societal issues

Title: Knowledge Federation – An Enabler of Systemic Innovation

Author: **Dino Karabeg**

Institute for Informatics, University of Oslo
dino@ifi.uio.no, +47 4129 2049, POB 1080 Blindern, 0316 Oslo, Norway

Dino Karabeg began his career as a researcher in environmental system modeling at Ruđer Bošković Institute, Zagreb. Following a doctorate in algorithm theory at the University of California at San Diego, and several university appointments in USA and France, in 1992 Karabeg accepted an Associate Professor position at the University of Oslo Informatics Department and moved to Norway. Soon after that his interest changed to systemic innovation in knowledge work, as he grew convinced that knowledge work can and needs to be developed on different premises, not as an attempt to objectively depict reality, but as it might help people and society orient themselves in a complex reality. From that point on Karabeg devoted his career to developing what he saw as various building blocks and contours of a new – self-aware, and self-organizing – approach to knowledge. His goal is to complete a prototype of a knowledge work as it might suit our times and condition.

Keywords: systemic innovation, knowledge federation, socio-technical system design, innovation journalism

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Introduction

If we let Triple Helix symbolize collaboration across domains, and we let Silicon Valley symbolize innovation in information technology, then the forthcoming Triple Helix conference in Silicon Valley might remind us of the opportunity – and *be* the opportunity – that collaboration across domains becomes a motive for a new wave of IT innovation, and that new information technology elevates collaborative knowledge work to new heights. This article will introduce Knowledge Federation as a missing piece needed to enable such development.

Figure 1: Knowledge Federation is introduced as a missing piece that can enable IT innovation to expand to socio-technical system design. (Courtesy Mei Lin Fung)

As Wikipedia and World of Warcraft might illustrate, information technology can now power completely new ways for people to cooperate across the globe and co-create knowledge and tackle challenges; and yet knowledge-work *practices* in key domains including education, science, journalism and governance have remained largely as they have evolved based on printed text as medium – this article, and all our articles, being a case in point. This article will attempt to make a case for large-scale systemic innovation, and outline a method by which such innovation might become practical. This will be done by describing Knowledge Federation, a prototype implementation of that method.

While Knowledge Federation is a relatively recent initiative, it continues a line of work that already has a half-century long history. In early 1950s, when the few computers that existed were number crunching behemoths, Douglas Engelbart dared to dream about networked computers enabling people to think and create together: "[…] I dreamed that people were talking seriously about the potential of harnessing a technological and social nervous system to improve the IQ of our various organizations. What if, suddenly, in an evolutionary sense, we evolved a super new nervous system to upgrade our collective social organisms? Then I dreamed that we got strategic and began to form cooperative alliances of organizations, employing advanced networked computer tools and methods to develop and apply new collective knowledge." (Engelbart, Landau and Clegg, 2009). This (applying our collective creativity to improve our collective creativity) Engelbart saw as the best investment of our creative potential towards handling the increasingly complex problem that the humanity would be facing. The pursuit of this dream made Engelbart a premier Silicon Valley inventor: in 1968 when the communication with computers was through punched cards and printed output, he demonstrated the use of computers as we know it today – interactive video terminal with windows, collaborative text editing over a distance, video teleconferencing... (Engelbart et al., 1968) – all developed in his laboratory at Stanford Research Institute. But those inventions were only initial steps in a more ambitious project, whose goal was to develop completely new patterns for collaborative knowledge work, which would radically improve our collective abilities.

We attribute to the term *knowledge federation* the following three meanings:

- As an activity, *knowledge federation* aims to complement the current focus on document production by providing meaningful organization, evaluation of relevance and synthesis of shared meaning, across professional, cultural and geographic divisions. A goal of *knowledge federation* activity is to mobilize the human, technical and other resources towards augmenting the *quality* of knowledge.
- As a principle of organization, *knowledge federation* is a 'post-discipline,' a way to organize knowledge work analogous to the value chain in business. In a *knowledge federation* experts from diverse disciplines join other stake holders and sponsors to work on a specific issue. A goal of *knowledge federation* as principle of organization is to reallocate the human and other resources to bear upon *contemporary* challenges.
- As a concrete community-and-project, Knowledge Federation is an instance of a *knowledge federation* or post-discipline, organized to work on socio-technical system design and systemic change. A more specific task of Knowledge Federation is to develop *knowledge federation.* As outlined below, Knowledge Federation undertakes to work on those tasks by implementing a specific way of working and strategy.

The rest of this article is organized as follows. The State of the Art section presents a case for systemic innovation. The Methodology section outlines an innovation method that might facilitate or even enable this practice. The two sections that follow describe two examples of knowledge federation practice. Section Policy Implications points at systemic innovation as a suitable paradigm for handling contemporary issues. Future Research will summarize our action plan.

State of the Art

"For three thousand years, we have struggled to answer the great questions: the what, the where, the how and the why of mankind and our planet," reads the text at the back cover of BBC's DVD set "The Story of Science." But the awe-inspiring story of science also has a shadow side: it makes the selected – and publicly sponsored – minds focused on those great old questions, while the condition of mankind, and of our planet, may demand their attention.

Even if one's sole interest might be to advance knowledge *in a traditional academic discipline* such as sociology, as Pierre Bourdieu observed already in late 1980s that is – before the Web – the line of fastest progress would still be pointing at systemic reorganization (Bourdieu, 1991). And if our aim is to create knowledge that is most relevant to society, the advantages of systemic innovation can be enormous (Karabeg, 2009)!

For centuries, academia has had a most sensitive role in our culture – the role of a *meme custodian*, that is, of a trusted and sponsored creator, selector, caretaker, setter of standards and communicator of worthwhile ideas, thought forms and other cultural goods. When the networked media technology appeared on the cultural scene as an enormously powerful meme disseminator, in an ideal world the academia would have grasped this opportunity to implement its key functions in this new medium, but that is not what happened. Much of the power of the new media now seems to be controlled by commercial and other interests that are contrary to academic purpose and spirit. It remained to Andrew Keen to diagnose that the Internet disintermediated the expert; and to Nicholas Carr to bemoan the *shallowing* of culture.

Similar conclusions are reached when we look from the point of view of business. In education, academia, public informing, governance – the largest potential markets for the IT industry – conventional practice still follows the patterns developed for old technology. At the same time, the IT industry follows its own conventional focus – technology. This leaves the non-trivial task of reorganizing knowledge work – and any other work – as it might suit the new technology to users. Can we leave it to practicing researchers, or policy makers, educators and journalists, to find out how to improve the effects of their work by applying, say, the Semantic Web technology or video conferencing? Imagine if the automobile industry were producing and selling automobile parts – transmissions, motors, wheels... – and expecting that the buyers would assemble the vehicles – even when nobody yet has a clue about what a complete vehicle is supposed to look like!

Looking from the point of view of governance, we may ask whether the socio-technical system drafted by Founding Fathers more than two centuries ago still works? Are people still in control? Do we know what we need to know to make informed decisions?
The new networked media technology amounts to pervasive, easily reconfigurable, even programmable connecting tissues in our collective organisms, allowing us to configure any sort of organizational structure we might be able to imagine. But in spite of its potential benefits, the practice of systemic innovation is still practically nonexistent. What do we need to do to enable its development?

Methodology

If we imagine the Web as a gigantic computer, then the corresponding notion of 'program' might be a new way how people and technology are combined in the creation of knowledge, or any other task.

An obstacle that hinders the development of this new sort of 'programming' is that we are still lacking both the 'programmer' and the 'machine.'

The difficulty associated with the 'programmer' is that no programmer team and no company has the expertise or the authority to develop socio-technical systems on this large scale; no game designer can change 'the academic game' or 'the journalism game' — the people actually working in academia and journalism must make the change themselves. But they of course cannot do that alone – at the very least they need to collaborate with technology experts, and – since the technology still only provides the tools – people who can creatively use those tools to do visual communication and knowledge organization and... And then there are also business and legal constraints that a new way of working might need to accommodate. So an entity suitable for systemic innovation would need to have an organizational structure is pretty much an antithesis to the conventional company or discipline.

An even larger difficulty is to secure the 'machine': It is obvious that large-scale systemic solutions must be implemented and tested and even allowed to *evolve* through use before they can be put into normal practice. In what medium can we implement those systemic prototypes? It might appear that the Web is a suitable medium, but the Web still lacks an essential part of our 'machine,' namely the people. The 'programs' we are aiming to create are *socio*-technical systems. The people who partake in those systems cannot be kept in a laboratory and programmed.

An in principle solution to this puzzle has been given by Douglas Engelbart; he called it 'bootstrapping.' Engelbart's key observation was that a community of designers practicing systemic innovation must use *their own community* as sandbox or environment or 'machine' to develop and test solutions. Bootstrapping was routinely used in Engelbart's laboratory.

Knowledge Federation applies bootstrapping to provide both the 'programmer' and the 'machine' for systemic innovation; in fact, Knowledge Federation *is* both the 'programmer' and the 'machine'!

Knowledge Federation is a community of professionals and stake holders with a suitable mix of backgrounds, equipped with suitable technology, who have come together to co-create socio-technical systems in key areas – which makes it a suitable 'programmer' (Karabeg, 2011a).

Knowledge Federation develops, tests and deploys its designs by practicing self-organization or bootstrapping – which makes it a suitable 'machine' (Karabeg, 2011b).

Several prototype socio-technical designs are already under development, two of which are briefly described below.

Result 1: Knowledge Federation (KF) Prototype

The KF *prototype* is a *prototype* of a knowledge federation as post-discipline – a new basic unit of systemic organization of knowledge work, where experts and other stake holders from a variety of disciplinary and other backgrounds come together, without giving up their original professional allegiances, to accomplish a specific task. The task of Knowledge Federation is to develop knowledge federation and to bring it into regular practice.

A use case might be as follows: An IT business realizes that the technology it produces can power a new way of doing university education and joins the Knowledge Federation Course KF project to realize this potential. Alternatively J, a journalist, realizes (a) that journalism is lacking a viable business model that would make it sustainable in the presence of abundant free information and (b) that commercial journalism fails to fulfill the basic social role that journalism needs to fulfill in contemporary society; J decides to become a journalism designer and joins the Knowledge Federation Media Channel project to pursue this task.

Knowledge Federation is composed as a federation of eight projects, each conceived to be an engaging, cooperative *game-changing game* in a specific domain (Karabeg, 2011b). Together, those projects compose Knowledge Federation as the general game-changing game – a community of interest capable of doing systemic innovation in any domain.

Knowledge Federation community has been initiated during the Topic Maps Research and Applications conference in Leipzig, Germany, in October 2007.

The First International Workshop on Knowledge Federation, organized in 2008 in Inter University Centre Dubrovnik, Croatia, was a meeting of technical researchers to begin mapping technical tools and approaches to collaborative knowledge work and to developing a research community The second workshop, in October 2010 in the same venue, brought together also experts in journalism, scientific organization, intellectual property law, visual communication, business modeling… – a combination of backgrounds needed for socio-technical system design. At the beginning of the workshop we were asked to consider ourselves not as professionals pursuing a career in our chosen discipline or profession, but as elements in a collective, and at the limit *global* mind, and to begin to self-organize as it might best suit this role. The name of our workshop, “Self-Organizing Collective Mind,” combined with our expressed core goal – to “foster the meme of self-organization in knowledge work” – made it clear that our main objective was to initiate a new direction in knowledge work, where knowledge work recreates itself to better serve the society.

During the three working days of our second workshop, in October 2010 in the same venue, we worked respectively on systemic solutions for journalism, science and education. At the last day of the workshop the Hosting Team was created, as an embryo of the future organizational leadership. During the ensuing months the community development and consolidation of its various activities continued through a Ning-based social networking site and through email, which ultimately led to the project structure indicated above. We are currently developing a new, Drupal-based community website to support the new organizational structure.

If all goes well, we will open the new community website KnowledgeFederation.net, and the restructured Knowledge Federation community, at our workshop at Triple Helix IX conference.

Result 2: Tesla and the Nature of Creativity (TNC) Prototype

One of the activities the Knowledge Federation community engaged in after its second workshop was to *federate* the contributed articles: Instead of automatically resorting to peer reviews, we decided to use this opportunity to discover and begin to develop completely new procedures. The TNC *prototype* is a result of this experiment.

In the associated use case, a scientist makes a discovery that has potential to impact other disciplines or the culture at large. Realizing that a publication in his field would come short of this potential, he decides to have his work federated. This story is a real one – the scientist is Dejan Raković, University of Belgrade quantum physicist, who got interested in seemingly incredible creative feats of the great inventor and his compatriot Nikola Tesla, and found out that the perplexing phenomenology of Tesla's creativity can be modeled and explained within the paradigm of quantum physics.

An attractive side of Raković's model is that it has potential to broaden the conventional understanding of the nature of creativity in life sciences, and even impact the popular worldview.

In the TNC Prototype Knowledge Federation project we do not act as advocates of Raković's result; on the contrary – we develop around it a transparent and reliable mechanism for federating important insights. This mechanism is rather like a fine scale, on whose 'pro' and 'con' side anyone who has competence can put arguments to be publicly weighed. For this purpose, Raković's result simply plays the role of "a discovery that has large potential impact."

The TNC prototype currently has three modules, each developing and exhibiting distinct possibilities for both knowledge federation and knowledge federation research (Karabeg and Raković, 2010). Regarding the latter, we show how socio-technical designs may be developed with rather simple means – i.e. by using already existing technology as building blocks for creating new systemic patterns.

The TNC Idea Maps module exhibits a procedure – implemented by using the Cohere online idea mapping tool (Buckingham Shum, 2008). In our procedure

- ideas are freed from the jargon of a discipline and made available online
- ideas are interlinked with other related ideas
- questions are linked with ideas to solicit further details from the author or the community
- key insights or gestalts are distilled from interlinked ideas
- ideas and "gestalts" are submitted to a democratic deliberation process online, and allowed to either acquire or lose credibility, and to eventually become community views;
- gestalts and related insights and documents are brought to the attention of communities where they may have high impact;
- *gestalts* and related insights and accompanying media attractive materials are made available to journalists and to general public.

The TNC Multimedia module shows – by using the Acrobat Professional – how a conventional article may be turned into a multimedia object by adding

- a videotaped introduction
- a graphical presentation of main ideas and their relationships
- a navigation structure
- highlights of key insights
- recorded interviews with the author to provide additional clarifications

The TNC Dialogs module combines a modification of David Bohm's physical dialog technique with online dialogs and media action to implement a community-wide process of worldview change.

Conclusions

As pointed out in Introduction, the substance of this discussion has been to outline Knowledge Federation as an approach or method for doing systemic innovation. The title of this article has boldly announced this method as *enabler* of systemic innovation. The question remains – is there any substance to this claim? Does Knowledge Federation indeed have a value proposition?

When we discussed this question within our workshop team, an objection was immediately raised that the times have radically changed since the times when Engelbart worked as a lonely visionary and pioneer. Collaborative knowledge work is now a household term in a number of

communities of practice, many of which are doing excellent work. We cannot possibly justify the claim that we have an original solution! (You will recognize here an issue that motivates knowledge federation – difficulty or impossibility to put together all data that might be needed to substantiate a claim.)
What we *can* do, however, is *federate* our claim! Here is how: I will draft an argument based on above data, and challenge you to produce a counter-argument or counter-evidence, via emil or Skype and email, or in a hallway or during a coffee break at Triple Helix IX. So here is my argument.

Imagine that you have, like journalist J, decided that pursuing a career in your profession as it is has systemic innovation as more attractive alternative. (I myself can easily do that – I do academic work being convinced that academia 'has a flat tire' – i.e. that it needs to stop and take care of its structural problems, see Karabeg, 2010.) What will you do? Where will you go? The challenge – to recreate journalism, or the standard way of practicing any profession – surely does seem overwhelming!

In our conversation I asked my workshop colleagues to imagine J walking around downtown Palo Alto (a metaphor for touring research and innovation projects in Silicon Valley on in cyberspace) looking for a suitable shop to enter. (I was imagining not downtown Palo Alto as it is today, but as it might have been fifty or hundred years ago, with old-fashioned businesses where you could have your suit or your shoes tailored to your own liking and dimensions.) You are looking for a place where you might have your *profession* re-designed, not only as it suits you personally, but more importantly as it might suit the world we live in. (As explained I below, I predict that there will be a growing market for this type of business.) So my claim, or perhaps better said my 'working hypothesis' – which I can only substantiate with your help, namely through federation – is that *there is no such store*.

If I am wrong, if you know of such a store (meaning community or project), please let us know right away. Otherwise we will be inclined to believe – and grow more and more convinced – that we should (metaphorically speaking) open a Knowledge Federation worksho in downtown Palo Alto and do good and useful business!

At our workshop "Openness, the Quadruple Helix & Knowledge Federation" at Triple Helix IX conference at Stanford we intend to make our systemic innovation services available to the Triple Helix community, and to Silicon Valley creative IT developers and entrepreneurs.

Policy Implications

In "The World in 2011" special issue of The Economist, Arianna Huffington writes under the title "The year of hope 2.0":
"In America, 2008 was all about 'hope': crossing our fingers and electing leaders who we thought would enact the change we desperately needed. Gazing into my crystal ball, I predict 2011 is going to be all about hope 2.0, the realization that our system is too broken to be fixed by politicians operating from within it."

When a mainstream journal like The Economist gives voice to an unconventional idea — that our problems will not be solved by politicians acting from within the system — then that might be a sign that this idea is about to become mainstream. We may help it become mainstream, by federating already published insights that support it (Karabeg, 2011c).

A single policy recommendation that follows from above discussion is to consider systemic innovation or improvement (Karabeg, 2011c). In a recent blog post I have highlighted the naturalness of this way of handling issues by evoking the analogy with having a flat tire – which obviously needs to be perceived and handled as a structural defect – but which one might also try to handle at the level of specific 'problems' such as the difficulty to keep a steady direction, and the smell of burned rubber, while continuing to drive along. In a similar way, many if not all of our messy or wicked 'global problems' will, I believe, end up being perceived and handled as consequences of structural defects.

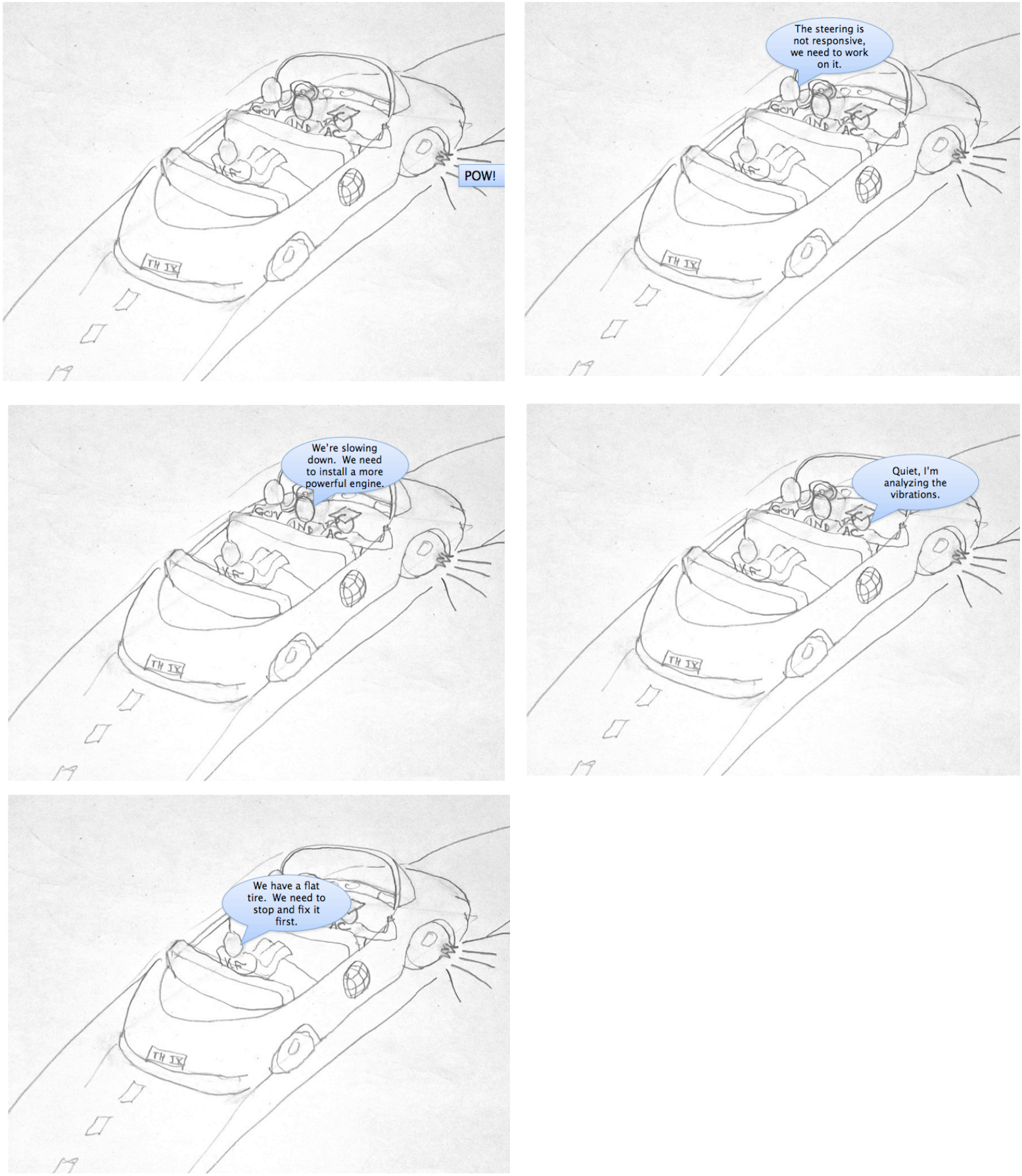

Figure 2: By providing reliable shared insights, Knowledge Federation enables systemic improvement. (Courtesy Rob Stephenson)

Knowledge Federation might facilitate or enable the change to systemic action in two ways:

- as a suitable source of collective vision – which might enable us to perceive systemic causes;
- as a venue for systemic innovation – which might enable us to handle systemic causes.

Directions for Further Research

As Triple Helix is preparing to meet Silicon Valley at Triple Helix IX conference at Stanford University, we consider this to be an opportunity for IT innovation to expand to systemic innovation. By this we mean primarily systemic innovation for collaborative knowledge work, but also systemic innovation in general. Our immediate concern is to see if Knowledge Federation might serve as facilitator or enabler for such development. We will come to Triple Helix IX equipped with our toolkit, and we are preparing to engage the participants in hands-on redesigns by federating ideas with at least one more workshop that has related interests. We will also open up our community and our projects to receive new members and impulses.

For subsequent immediate future, we are planning a Knowledge Federation workshop in Barcelona in November, a large part of which will be dedicated to developing the Knowledge Federation Media Channel (our game-changing game in public informing) and the Knowledge Federation Course (our game-changing game for education).

The Knowledge Federation Course should be offered in October 2012, along with our 2012 meeting in Dubrovnik. The course will be offered to graduate students from selected international universities, through the Inter University Centre Dubrovnik which is chartered to give accredited courses to students of its member institutions.

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