

# Towards Bottom-Up, Stakeholder-Driven Research Funding – Open Science and Open Peer Review

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**Abstract:** The current practices of research funding do not yet use means of communication and collaboration of the Internet age effectively. Combined with a number of information flow barriers associated with research funding this results in inefficiencies and intransparencies. We present a vision how an open science platform for research funding and cross-fertilization could be realized. It is based on stake-holder involvement and community self-organisation. We identify problems which have to be solved in order to realize this vision and present with Cofundos a concept and portal which already implements a simplified version of the envisioned open science model for the pooling of ideas and resources regarding open source software development.

## ***Introduction***

Nowadays scientific research is regarded as the main source of economic wealth (Kline and Rosenberg, 1986; Lundvall et al., 2002) and as a means expected to solve ecological and social problems (Beck, 1992; Beck, 1999). These expectations are hardly compatible with the idea that science is functioning like a self-regulating system concerning its mechanisms of evaluating the “relevance” and even the “quality” of research projects. We observe an ongoing trend of increasingly incorporating prospective societal impacts into the decisions about funding of research projects and proposals (Guston and Keniston, 1994; Nowotny et al., 2001).

Societal impacts consist of all the demands, expectations, and interests the various stakeholders, actors, institutions and social movements have. These include the commercialization of research results, supporting knowledge transfer between geographical regions, organizations or groups of people, strengthening the competitiveness of enterprises on the one hand and interests formulated by actors of a civil society like organization of the general welfare (e.g. Unicef), environmentalists, or humanitarian activists (Hess, 2005) on the other. Such objectives appear reasonable with regard to the fact that research is often ultimately funded by tax payers and consequently scientific communities should be accountable on how they contribute to the societal advancement.

When analyzing the practices of funding agencies (such as the European Union, national or federal ministries or private foundations), however, we gain the impression that the measures used to trigger societal impacts are not always very efficient: Funded research projects tend to be large since funding agencies believe a big impact requires big investments (cf. Münch,

2007). Large science projects are due to the uncertain nature of scientific progress very hard to plan a priori. Scientists tend to write proposals in such ways they think maximize their chances to get funded - but a pretty proposal does not guarantee excellent results. The few evaluators and reviewers of a specific proposal or project might often be experts in the area but are usually not direct stakeholders of that project and thus their valuation of the potential impact or success of a project is a rather rough estimate. Collaboration and interdisciplinary were identified as success factors for innovation (Hollingsworth, 2002), but each additional partners also potentiates communication and management overhead (cf. the case study of: Latour, 1996).

In order to overcome the mentioned obstacles we argue that new ways of research funding should be sought, which are stakeholder-driven, spur bottom-up innovations and complement thus existing funding instruments. We envision a funding model, which is based on a platform for the discussion of research ideas and their prospective outcomes. The actual funding decision should be based on the number of votes from stakeholders, i.e. users/applicants of the research result or companies interested in their commercialization. In order to not disadvantage research projects, with a small but strong number of stakeholders, participants could be equipped with a number of votes, which can be either spread across several project ideas or awarded bundled to one.

Such a system would have a number of advantages: it will precisely reveal the stakeholders of certain research results; it will make the interfaces between research results clearer; researchers are better accountable for really achieving the initially defined requirements; the model would have a very low overhead, since communities of researchers, stakeholders could organize themselves, given a Web platform which facilitates the description, browsing, searching of projects and automates the voting processes. This platform probably enables an arena for communications and funding decisions that is satisfying the demands of the stakeholders and the community of scientific practices as well, to an extent that goes beyond already existing funding procedures. Moreover, from our point of view it is worth to discuss how this platform can really comply with the norms, like transparency, equality, free exchange of knowledge (cf. the normative approach of: Merton, 1973 [i.O. 1942])) of a science perceived as a democratic institution.

In order to showcase the practicability of such a model we implemented such a platform and in order to test their feasibility we adopted the platform firstly for the development of open-source software. The platform works as outlined, but participants are users and developers of open-source software and the funding of projects is provided by pooling donations from stakeholders. The platform is online at <http://Cofundos.org> and is actively used.

### ***Information flow barriers - a cause of lacking applicability of research***

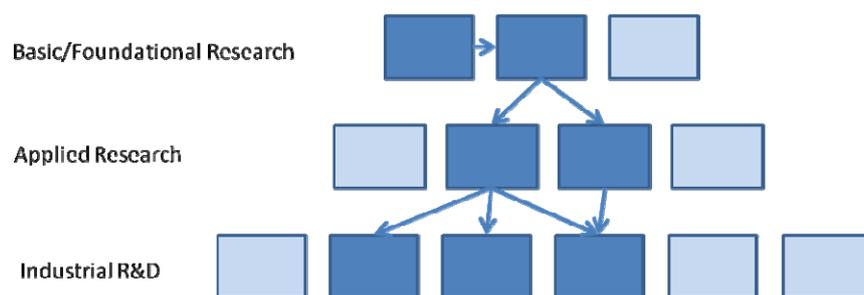
The lacking applicability is from our point of view neither primarily caused by researchers nor by politics, but a result of information flow barriers which we sketch in the following:

- 1) **Potential users of knowledge and technologies are hardly able to determine whether other stakeholders for a certain R&D problem exist and who they are.** This is due to the fact that there are no communication channels for announcing R&D needs and respective requirements. The lacking overview over research needs prevents individuals or organizations to join ideas and resources to collectively solve the R&D needs.
- 2) **It is very difficult for governmental research funding agencies to determine the actual research and knowledge (transfer) needs of groups of citizens or organizations which should be supported** (such as companies in economically underdeveloped regions, teachers in urban problem zones, start-ups in centers of

industrial growth etc.). The state as democratically legitimated institution represents its citizens but is not effectively able to determine the concrete needs of groups whose support is politically desirable.

- 3) **Researcher in different institutions learn relatively late from research efforts of their peers, which prevents coordination of their efforts, cooperation or mutual support.** Current practices of research funding are widely influenced by the principle of information restraint. Research proposals are kept secret, instead of publicizing and sharing them and publically discussing the ideas according to the ethos of open science.
- 4) **Even when end user groups are involved in the process of defining R&D projects these rarely have the opportunity to assess the scientific quality.** Within science currently only the academic reputation serves as a yardstick for excellence. Experiences of stakeholder groups are rarely documented and publicized.
- 5) **It is often unclear who the concrete stakeholders of certain research results are.** Research papers are evaluated by peers, who mostly are no direct stakeholders of the research being performed. Of course researchers motivate the importance of their results with prospective applications, but whether the results finally are ever applied in practice is often not obvious. For research stakeholders often completely different forms of knowledge transfer (than by means of scientific papers) have to be chosen (e.g. software implementations, tutorials, simplified usage scenario descriptions).

These information barriers are not always perceived negatively. Protected by such non-transparency it is possible for certain actors to push their interests. When we put aside such individual interests research funding might be optimized by overcoming these information barriers, especially for research projects and disciplines which aim to serve other stakeholders interests or focus on applications. Funding agencies were already developing various instruments in order to spur inter-disciplinarity, applications and cooperation between industry and research. Examples are collaborative research projects or voucher systems. In the following section we describe how an open science platform can integrate individual elements of such funding instruments in order to complement and strengthen them. Additionally the concept leverages novel collaboration and communication strategies of social software, open source and the Web 2.0.



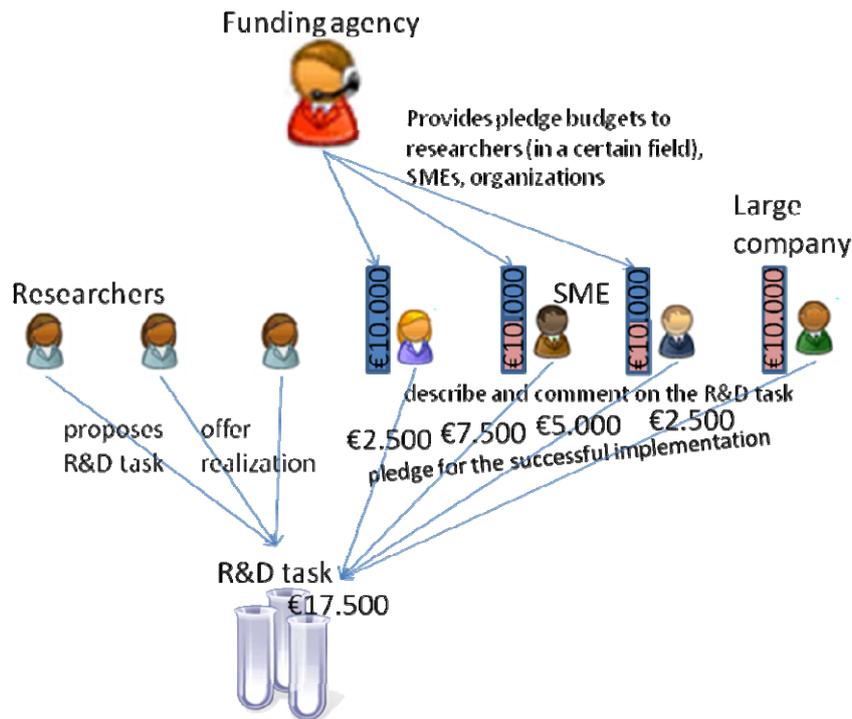
**Figure 1:** In an optimal world research results are building blocks for other areas of research and ultimately foster applied and industrial research. The open-science concept aims at showcasing the flow of information between areas of research and supporting those research projects, which are crucial for certain stakeholders.

### ***Stakeholder-driven research funding***

The concept of a stakeholder-driven, bottom-up research funding is based on the idea that researchers publish ideas for interesting research topics on an open-science platform as early as possible. Other researchers and stakeholders such as for example companies interested in a commercialization can comment on the research ideas, add requirements and pledge a certain

amount of money they would be willing to pay for a successful realization. Since a potential commercialization of research results often also depends on the advancement of more fundamental research, the researcher participants on the open-science platform themselves should be equipped (e.g. by a funding agency) with a certain budget they are allowed to grant to other research groups but not to use themselves. The budget could be either awarded completely to some other research group whose results are crucial for a certain research effort or distributed as small pledges towards a number of research efforts. When all research ideas and projects on the platform are considered it will be quickly obvious, which results are important for whom. This mechanism of enabling arbitrary splitting of the pledge budget would not only foster the realization of popular research projects, where many other peers are moderately interested in the results but also projects which have only a small number of very strongly interested parties. Once a project idea received enough pledges the funding agency can provide the funds for the project to start. While the project is running the involved investigators report publicly (e.g. by means of a project Weblog) about the proceeding. This enables the stakeholders to influence the projects for example in the case when requirements changed or alternative approaches are more promising. Once the project is finished the results are published on the open science platform, everybody is invited to comment on the success, but only the stakeholders (i.e. those who pledged a part of their research budget) are allowed to vote about the success and to write an evaluation report. However, these will be publically available and constitute the track record of a certain researcher. This can be important information for future decisions about whom to award a certain pledge.

A number of measures should be undertaken to make such an open science platform for all participating parties as beneficial as possible: Technically the platform should encourage small effortless contributions (such as comments and votes) by using Web 2.0 techniques such as AJAX. It should be easy to syndicate all content published on the platform, so that a researcher can integrate a list of his published research ideas on his homepage, a research group can integrate the contents of a project diary into their homepage, a funding agency can integrate information about funded projects into their Web site or a portal related to biotechnology can integrate recent ideas and developments in the area. Besides Web 2.0 syndication formats such as ATOM and RSS we also envision the use of Semantic Web technologies, tagging and folksonomies as well as vocabularies for the end-user driven structuring and annotation of ideas, projects, results and comments. It should also integrate social networking elements, in the way that researchers can collaborate and discuss ideas and topics in groups and have a personalized view on a neighborhood of peer-researchers and research topics.



**Figure 2: Schematic depiction of participants and interactions on an open-science platform.**

For funding agencies the use of such a platform for distributing funds would have a number of advantages:

- Increased transparency
- Increased effectiveness through cross-fertilization between different research and user groups
- Increased competition between and focus of research groups
- Self-organization of the peer-reviewing and evaluation process
- Targeted support for certain groups (e.g. woman in engineering, young researchers, small and medium enterprises) or topics (e.g. bio-technology, )
- Direct involvement of the real stakeholders in the project

**Use case scenario:** Vine-growers in south Baden noticed recently that their vine plantations are infected by a new type of fungus which does not respond to conventional fungicides. The caused damage is not immense. The spreading of the fungus is still limited on single plants. Nevertheless, the fungus causes concern to the vine-growers, since it is still unclear, how the parasite infesting will develop in future. The researchers at the department of wine-growing at the local university of applied sciences, who were contacted by the wine-grower cooperative, were unable to reveal details about the disease. After the researchers hear of the open-science platform they decided to photograph the fungus infection and to describe symptoms and occurrence. This information was entered as a new research task into the open-science platform, which is publicly accessible on the internet. A biologist from Hamburg, who rummages the platform for new project ideas, reads the problem description. She does not have a clue what could be the cause, but remembers a publication she recently read, which was reporting about a formerly unknown fungus infection in South Africa. The biologist emails the author, who quickly replies with additional information. On the basis of this information she prepares a project offer for the badenian wine-grower cooperation, which comprises the epidemiological and microbiological analysis of the fungus as well as an review of international publications regarding the occurrence and disinfection of the fungus. The project budget amounts to €30.000 plus €2.000 travel costs. The wine-makers accumulate

vouchers they were individually awarded by the ministry of economy of Baden-Württemberg until the respective sum is reached and grant the biologist from Hamburg the research project. After completion of the project the results are published on the open-science platform, including an assessment of the research results, which the wine-growers contribute.

Problems which would have to be solved are:

- What level of gratification is needed to ensure a qualitative review and evaluation process? Do we need to reimburse stakeholders additionally for reviewing and evaluating ideas and results?
- How are pledge budgets efficiently distributed? Initially all universities or university chairs for example could be equipped with a certain starting budget, should such an allocation occur every year or should successful participants get a larger share of new research budgets?
- What level privacy needs to be preserved – should all contributions be associated with real names, pseudonyms and should anonymous contributions be allowed?
- How can we effectively enable communities to structure their research ideas as easy and as much as possible and to employ these structure for enable efficient browsing, searching and syndication of content?

### ***Cofundos –First Experiences***

The realization of an open science platform as discussed in the last section requires significant efforts – funding agencies have to be convinced, a well balanced model of contributions and rewards ensuring a certain amount of privacy and provenance has to be developed, an internet platform, which organizes collaboration and communication according to this model has to be implemented. We estimate this effort to last several years and require a team of sociologists and computer scientists to work together. However, in order to start this process we already developed a simplified participatory R&D model and implemented it as Cofundos.org for the application of open-source software development. In this section we report about first experience with Cofundos.

Cofundos realizes the concept of stakeholder-driven research and development for the application domain of open-source development. Cofundos is based on principles which lay the foundation for a process which in turn is organized by means of a Web platform.

The Cofundos concept is based on the following principles:

- **Open-knowledge and open-source.** All ideas and contributions on Cofundos are licensed under a Creative Commons<sup>1</sup> Attribution 2.0 License. All project outcomes must be licensed under an Open Source Initiative (OSI) approved open-source license.
- **Reputation and community.** Bright ideas and excellent solutions often originate from outstanding individuals. But it needs a community to mature these ideas and solutions and in order to bring the critical mass together for their realization.
- **Fairness and trust.** An open, accountable and transparent environment will foster fair communication and trustworthy relationships between its users.
- **Big impacts can be achieved in small steps.** Conceiving and realising bright ideas does not require many year developments or huge amounts of funding. Their realisation can be achieved by bringing together innovative ideas with clearly defined features and requirements based on community involvement and fostering their accomplishment by committed specialists.

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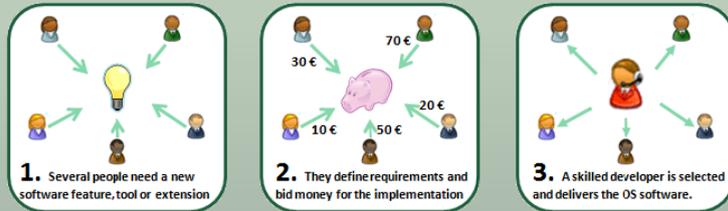
<sup>1</sup> <http://creativecommons.org/>

The Cofundos process itself works as follows:

1. **Somebody misses an open-source software** tool or library for a specific purpose, a feature in an open-source software or a plugin for an existing software. He describes the project to develop the software.
2. **Requirements-Engineering:** Other people help enhancing the description of the project by adding specific requirements and comments.
3. **Bidding:** Users who also like the project and need the resulting software, bid a certain amount of money, which they will donate to the project performer after its successful completion.
4. **Offering:** Specialists who are capable to perform the project and to develop the respective software offer to realise the project for a certain amount of money and within a certain timeframe.
5. **Call for competitive offers:** As soon as the sum of the bid amount exceeds the money requested by the first offer, a call for competitive offers is started and lasts for three week.
6. **Accepting an offer:** After the three weeks call period for alternative offers is elapsed, all bidders are requested to vote about which offer to choose. Bidders votes are weighted by the amount of their bid. The specialist with the majority of the votes is selected to carry out the project.
7. **Voting about project success:** After the specialist announces the completion of the project or the development timeframe as suggested by the specialist elapsed, the bidders vote about how the initially defined requirements (agreed on by the specialist) are met by the provided solution.
8. **Donation to the specialist carrying out the project:** If the majority of the bidders agree that the **requirements are met**, bidders are requested to make the respective donations.
  - If the majority of the bidders decide that the **requirements are only partially met** by the implementation, an extension will be granted to the specialist for improving his implementation.
  - If the majority of the bidders decide that the **requirements are not met** by the implementation, the project failed, no donations will be made and the project might be reopened for bidding.

The Web platform is implemented as a PHP Web application backed by a MySQL database. It supports the structuring of projects by means of tags and the browsing by means of a tag cloud. All content is in addition to being presented on a Web page exposed by syndication formats such as Atom/RSS, Linked Data and JSON. Users can register and login to Cofundos using OpenId – an open standard for single-sign-on into Web applications.

Cofundos helps to realize open-source software ideas, by providing a platform for their discussion & enrichment and by establishing a process for organizing the contributions and interests of different stakeholders in the idea.



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**News**

2 Dec 16:49: [Embed Cofundos.org into your Website](#) We released a kiosk modus for Cofundos today, which allows to embed the complete Cofundos.org functi...

10 Nov 21:56: [Cofundos.org redesigned](#) Michael Haschke (eye48.com) redesigned Cofundos.org. We hope the new Cofundos layout is clearer, bet...

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30 Nov 10:16: [Add support for for MTP devices to Indiana \(OpenSolaris\)](#) by [che](#)

Tags: [MTP](#), [Zune](#), [Samsung K3](#), [OpenSolaris](#), [Indiana](#)

29 Nov 11:22: [Self-installing binary release of current ImageMagick with PerlMagick for Debian variants like Ubuntu](#) by [guba](#)

Tags: [debian](#), [ImageMagick](#), [PerlMagick](#), [Ubuntu](#)

28 Nov 19:26: [Nautilus+Unison to remote and local synchronization](#) by [wladston](#)

Tags: [Plugin](#), [gnome](#), [sync](#), [unison](#), [nautilus](#), [remote\\_files](#)

28 Nov 17:09: [mono-runtime and gtk-sharp2 \(and required\) packages for OpenWrt](#) by [fabiani](#)

Tags: [GTK+](#), [Mono](#), [C#](#), [OpenWrt](#), [Embedded](#)

28 Nov 14:29: [Extension of COfundOS that identifies newsgroups from tags and posts a text to attract bidders and developers](#) by [guba](#)

Tags: [COfundOS](#), [extension](#)

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2 bids (€680) for [Globulation 2 Full Time Programmer](#)

Tags: [glob2](#), [Globulation](#), [c++](#), [ha](#), [mercurial](#), [rs](#), [job](#), [scons](#), [same](#)

3 bids (€655) for [Amazon EC2 AMI for MySQL Cluster](#)

Tags: [MySQL](#), [Amazon](#), [EC2](#), [AMI](#), [Cluster](#)

3 bids (€295) for [web interface for GTK+](#)

Tags: [interface](#), [gnome](#), [html](#), [GTK+](#), [web](#)

11 bids (€280) for [Social networking extension for Mozilla Thunderbird](#)

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**Recent bids**

€25 by [guba](#) for [Self-installing binary release of current ImageMagick with PerlMagick for Debian variants like Ubuntu](#)

€30 by [mmein](#) for [Globulation 2 Full Time Programmer](#)

€50 by [che](#) for [Add support for for MTP devices to Indiana \(OpenSolaris\)](#)

€10 by [soeren](#) for [Nautilus+Unison to remote and local synchronization](#)

€5 by [wladston](#) for [Nautilus+Unison to remote and local synchronization](#)

€100 by [fabiani](#) for [mono-runtime and gtk-sharp2 \(and required\) packages for OpenWrt](#)

€20 by [guba](#) for [Extension of COfundOS that identifies newsgroups from tags and posts a text to attract bidders and developers](#)

[amarok](#) [API](#) [Atom](#) [auto-update](#) [blender](#) [bug](#) [C++](#) [Calendar](#) [codec](#) [Database](#) [data](#) [integration](#) [DBpedia](#) [deb](#) [debian](#) [Description](#) [DL-Learner](#) [drupal](#) [Embedded](#) [export](#) [Extension](#) [Facet-based](#) [browsing](#) [faceted-search](#) [Firefox](#) [geography](#) [geo](#) [rss](#) [GIMP](#) [GIS](#) [glob2](#) [Globulation](#) [gnome](#) [Google](#) [grass](#) [GTK+](#) [GUI](#) [hg](#) [IDE](#) [IM](#) [image](#) [image\\_processing](#) [instant](#) [Interface](#) [Java](#) [kToon](#) [LaTeX](#) [library](#) [LinkedIn](#) [linked\\_data](#) [linux](#) [livecd](#) [logic](#) [logo](#) [media](#) [mercurial](#) [mobile](#) [Movie](#) [Mozilla](#) [MySpace](#) [MySQL](#) [nautilus](#) [Ontology](#) [OntoWiki](#) [OpenWrt](#) [OWL](#) [package](#) [Parser](#) [PHP](#) [picture](#) [Pidgin](#) [Plugin](#) [PostGIS](#) [PostgreSQL](#) [qqis](#) [Qt](#) [Quicktime](#) [RDF](#) [rhythmbox](#) [RSS](#) [rts](#) [Science](#) [Semantic](#) [Web](#) [smartphone](#) [strict](#) [SVG](#) [Symbian](#) [sync](#) [Synchronisation](#) [tag](#) [Thunderbird](#) [topology](#) [unison](#) [Video](#) [Virtuoso](#) [Windows](#) [wordpress](#) [WYSIWYG](#) [xhtml](#) [XML](#) [XSL](#) [XUL](#)

**Figure 3:** Cofundos.org homepage summarizing important information about new projects, popular projects, and recent pledges. Projects are categorized using tags and can be explored via a tag cloud.

The Cofundos concept attracted quite some interest: 20.000 people visited the Cofundos.org Web site in the first 3 months, more than 300 of them registered, ca. 100 project ideas were submitted and 170 pledges were amounting to almost €10.000. A number of media were reporting about Cofundos and the project was actively discussed in the Blogosphere. A number of project on Cofundos were actively discussed and first projects are under

development. Experiences showed that the information exchange is at least as important as financial aspects. However, additional efforts have to be undertaken in order to permanently and successfully establish the Cofundos concept as a development model for open source software.

## ***Related Work***

There are already some approaches to better integrate stakeholders into the process of elicitation research and development requirements or the pooling and distribution of funds. Recent examples are Pledgebank, Fundable, Change.com or come Facebook-applications. These Web sites and services focus primarily on charitable, social or cultural projects. Comprehensive voting processes or specific support for R&D or software development is however not part of their offerings.

With regard to participatory software development there is the platform MicroPledge<sup>2</sup>, which started around the same time as Cofundos. Other than Cofundos, Micropledge is not primarily targeted at open source projects and also supports commercial software developments. MicroPledge is more closed since for example voting processes are less transparent and ideas and contributions are not freely licensed. MicroPledge is also more complicated since it allows sub-projects with sub-payments. In addition to that there are of course a number of one to one mediator platforms targeting software development services (e.g. OpenSourceExperts.com or SourceForge marketplace). These, however, lack the aspect of pooling ideas and resources within a community.

A number of strategies and initiatives is subsumed under the concept participatory budgeting. Their aim is to involve citizens as stakeholders of political budget decisions more directly into these budgetary decisions. The administration of a town or community strives to achieve more budget transparency and allows citizens to vote about the distribution of fund for at least a part of the communal budget. Such a participatory budgeting was introduced and implemented for the first time in Porto Alegre (Brasil) in 1989 (Herzberg, 2006). Within the Spendenparlaments (engl. donation parliament) in Hamburg<sup>3</sup> citizens are enabled to vote which charitable projects will be supported with donations. Another example is the People's £50 Million Lottery Giveaway<sup>4</sup>, an online voting about the distribution of £50 Million lottery revenues in Great Britain.

## ***Conclusions***

The current practices of research funding do not yet use means of communication and collaboration of the Internet age effectively. Combined with a number of information flow barriers associated with research funding this results in inefficiencies and intransparencies. We presented a vision how an open science platform for research funding could be realized. We identified problems such as the required privacy, gratification or semantic structuring levels, which have to be solved in order to realize this vision. With Cofundos we presented a concept and portal, which works very similar as the proposed open science model, but focuses on pooling of ideas and resources for open source software. The experiences with Cofundos showed, that such an end-user driven approach for R&D can be successfully implemented.

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<sup>2</sup> <http://micropledge.com>

<sup>3</sup> <http://www.spendenparlament.de>

<sup>4</sup> <http://www.thepeoples50million.org.uk>

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