

# TECHNICAL REVIEW REPORT

## Information and Communication Technologies ICT

*Project acronym:* NADINE  
*Project title:* New tools and Algorithms for DIrected NETwork Analysis  
*Grant agreement number:* 288956  
*Funding scheme:* ICT FP7 — FP7-ICT-2011-C (CP)  
*Project starting date:* 01/05/2012  
*Project duration:* 36 months  
*Coordinator:* Dima Shepelyansky  
*Project web site:* <http://www.quantware.ups-tlse.fr/FETNADINE/>

*Period covered by the report:* Period No. 2, from 01/11/2013 to 30/04/2015  
*Place of review meeting:* Brussels, Belgium  
*Date of review meeting:* 02/06/2015

*Experts:* Maciej Nowak, Jagiellonian University,  
 Faculty of Physics, Astronomy and Applied Computer  
 Sciences, Poland;  
 Juan Pavón, Universidad Complutense de Madrid, Spain;  
 Piet F.A. Van Mieghem, Delft University of Technology,  
 The Netherlands.

*Project officer:* Andrea Feltrin

Individual report	<input type="checkbox"/>
Consolidated report	<input checked="" type="checkbox"/>



## 1. OVERALL ASSESSMENT

### a. Executive summary

*Please give your overall assessment of the project, commenting on the following:*

- *main scientific/technological achievements of the project*
- *quality of the results*
- *attainment of the objectives and milestones for the period*
- *adherence to the workplan, any deviations (whether justified) and remedies (whether acceptable)*
- *take-up of the recommendations from the previous review (if applicable)*
- *contribution to the state of the art*
- *use of resources*
- *impact*

The project has achieved the main scientific/technological objectives that were stated in the Description of Work (Annex I to the grant agreement). In concrete, the project has generated and evaluated new algorithms to facilitate classification and information retrieval from large directed networks, based on PageRank and CheiRank with two-dimensional ranking. The Google matrix formed by the links of the network has been analyzed using Stochastic Processes, Random Matrix Theory and Quantum Mechanics (quantum chaos) and by efficient numerical methods for large matrix diagonalization based on the Arnoldi method.

The project has fulfilled all deliverables and milestones and has resulted in collaborations between all partners. The project has produced a large number of publications in conferences/workshops as well as in relevant peer-reviewed international journals. Peer review for such publications also demonstrates the soundness and quality of the results. In total, the project has produced 73 papers and preprints. The publications include 2 papers in PLoS ONE and Sci. Reports. The PLOS paper has been highlighted by Guardian, Independent, Le Figaro, EC CORIDS and the press in about 20 countries. The Sci. Reports paper has been highlighted by the Independent and the MIT Tech. Rev.

The achievement of the objectives and milestones for the project is therefore highly satisfactory.

All the deliverables are accepted.

The workplan has been followed as expected.

Some of the considerations from the first review have been followed. For instance, some tasks have been finally executed collaboratively (e.g. in the form of joint publications), although not too many. Recommendations concerning a stronger visibility of the web site and on the impact of the project have only been followed partially.

The contribution to the state of the art of the relevant disciplinary domains is convincingly demonstrated by the numerous publications in peer-reviewed journals, and the material that is made available from the web of the project.

The use of resources is in line with the description of work and satisfies the principles of economy, efficiency and effectiveness.

The project has achieved some impact, especially in the academic world, and in some cases could be measured via the citations to the publications, or some citations in press.

However, the dissemination in the EU industry, which was one of the objectives in the initial technical annex, has not been sufficiently addressed. In this sense, the impact of the project is mostly limited to the academic world. Also, the web site has not been too much promoted and this also limits the impact, even if the results are of high interest and quality.

Notwithstanding these minor shortcomings, we believe that the effects of the project will be more visible at longer time scale, due to the high quality of the fundamental research performed during the project. In particular, random matrix generator of the xorshift type, developed as a byproduct, represents extremely high quality and is faster comparing to similar commercial alternatives. This generator was already implemented in Julia language, one of the most promising high-performance dynamic programming languages for technical computing, freely licensed by MIT. Other examples of possible high impact include novel recommendation systems and a matrix analysis of multiproduct world trade networks.

b. Recommendations concerning the period under review

*Please give your recommendations on the acceptance or rejection of resources, work done and required corrective actions – e.g., resubmission of reports or deliverables, further justifications, etc.*

All the deliverables are accepted.

c. Recommendations concerning future work

*Please give your recommendations – e.g., overall modifications, corrective actions at WP level, re-tuning of the objectives to optimise the impact or to keep up with the state of the art, better use of resources, re-focusing, etc. Where appropriate, indicate the timescale for implementation.*

N/A

d. Assessment

- Excellent progress (the project has fully achieved its objectives and technical goals for the period and has even exceeded expectations).
- Good progress (the project has achieved most of its objectives and technical goals for the period with relatively minor deviations).
- Acceptable progress (the project has achieved some of its objectives; however, corrective action will be required).
- Unsatisfactory progress (the project has failed to achieve key objectives and/or is not at all on schedule).

## 2. OBJECTIVES and WORKPLAN

### a. Progress towards project objectives

*Assess to what extent the objectives of the project for the period have been achieved. In particular, please indicate if the project as a whole has been making satisfactory progress in relation to the Description of Work (Annex I to the grant agreement) and comment on the interaction between the work packages and the level of integration demonstrated.*

The objectives of the project, more specifically the scientific goals stated in the Description of Work (Annex I to the grant agreement) have been achieved with outstanding results. The integration of the work carried out in the different work packages has been consistent with the Description of Work.

### b. Progress in individual work packages

*For each work package (WP), assess the progress in relation to the Description of Work (Annex I of the grant agreement). Please also report and comment on any delays, reasons for them and any remedial action taken. Specify the work packages concerned.*

- WP1 (CheiRank versus PageRank, centrality measures and network structure). The progress has been in line with the Description of Work, and the milestones have been successfully achieved.
- WP2 (Network analysis through Google matrix eigen-spectrum and eigen-states). The progress has been in line with the Description of Work, and the milestones have been successfully achieved.
- WP3 (Applications to voting systems in social networks). The voting application has been finished and finally the milestones have been successfully achieved.
- WP4 (Applications of new tools and algorithms to real-world network structures). The progress has been in line with the Description of Work, and the milestones have been successfully achieved.
- WP5 (Database development of real-world networks). The progress has been in line with the Description of Work, and the milestones have been successfully achieved.
- WP6 (Management). The progress has been in line with the Description of Work.
- WP7 (Dissemination). The progress has been mostly in line with the Description of Work. More effort was needed to increase the visibility of the project web site and better convey the project outcomes.

### c. Milestones and deliverables

*Indicate whether the planned milestones and deliverables have been achieved for the reporting period (please give more detailed comments first and then fill in the summary table below).*

During the second period of the project, main efforts have been devoted to milestones M5 to M14: network-specific centrality measures (M5), fractal Weyl law properties of networks (M6), protocols for large-scale network processing (M7), characterization of multiproduct world trade network (M8), webcrawler development and database collection (M9), Monte Carlo algorithms for centrality measures (M10), delocalization conditions for Google matrix eigenstates (M11), new protocols for social voting and recommendation (M12), characterization of ranking of Wikipedia and other networks (M13), characterization of time-evolving Web structures (M14). Milestones M1-M5 had been delivered in the first period.

Deliverables and milestones for the reporting period overall show a lot of good solid work, with a fair equilibrium of theoretical and practical achievements.

Therefore, all deliverables are approved, as shown in the next table, without any specific remarks.

STATUS OF DELIVERABLES			
No.	Title	Status	Remarks

		<i>(Approved/Rejected)</i>	
D1.2	Period 2 scientific report on WP1	<i>Approved</i>	
D2.2	Period 2 scientific report on WP2	<i>Approved</i>	
D3.1	Period 1 scientific report on WP3	<i>Approved</i>	
D3.2	Period 2 scientific report on WP3	<i>Approved</i>	
D4.2	Period 2 scientific report on WP4	<i>Approved</i>	
D5.2	Period 2 scientific report on WP5	<i>Approved</i>	
D6.3	Period 2 Scientific Report	<i>Approved</i>	
D6.4	Period 2 Periodic Report	<i>Approved</i>	
D6.5	Final Report	<i>Approved</i>	
D7.3	Contribution to portfolio and concertation activities at FET-Open level	<i>Approved</i>	

d. Relevance of objectives

*Indicate whether the objectives for the coming periods are (i) still relevant and (ii) still achievable within the time and resources available to the project. Assess also whether the approach and methodology continue to be relevant.*

The objectives were achieved through a consistent methodology as specified in the technical annex.

e. For Networks of Excellence (NoEs) only

*Assess how the Joint Programme of Activities has been realised for the period and whether all the planned activities have been satisfactorily completed.*

N/A

### 3. RESOURCES

#### a. Assessment of the use of resources

*Comment on the use of resources, i.e. personnel resources and other major cost items. In particular, indicate whether the resources have been utilised (i) to achieve the progress and (ii) in a manner consistent with the principle of economy, efficiency and effectiveness<sup>1</sup>. Note that both aspects (i) and (ii) have to be covered in your answer. The assessment should cover the deployment of resources overall and by each participant. Are the resources used appropriate and necessary for the work performed and commensurate with the results achieved? Are the major cost items appropriate? In your assessment, consider the person months, equipment, subcontracting, consumables and travel.*

The resources have been utilised to achieve the progress and in a manner consistent with the principles of economy, efficiency and effectiveness.

The deployment of resources overall and by each participant is consistent with the approved work plan. The resources have been properly used, in a consistent way, and following the needs for the work performed and commensurate with the results achieved.

The major cost items are appropriate.

#### b. Deviations

*If applicable, please comment on major deviations with respect to the planned resources.*

No significant deviations have been identified.

<sup>1</sup> "The principle of economy, efficiency and effectiveness refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimising the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved." Guide to Financial Issues, Version 02/04/2009, p.33.

#### **4. MANAGEMENT, COLLABORATION AND BENEFICIARIES' ROLES**

a. Technical, administrative and financial management of the project

*Assess the quality and effectiveness of the project management, including the management of individual work packages, the handling of any problems and the implementation of previous review recommendations. Comment also on the quality and completeness of information and documentation.*

Project management has been effective, providing a high degree of autonomy to each partner. As all of them have successfully developed their assignments, there have not been any significant management issues to deal with.

The quality and completeness of information and documentation that has been presented at the review meeting is satisfactory for this kind of project. The Periodic Report is quite extensive in the description of the work that has been done along the project.

b. Collaboration and communication

*Comment on the quality and effectiveness of the collaboration and communication between the beneficiaries.*

The authors of the NADINE papers mostly belong to individual partners of the Consortium. The recommendations of the first review to collaborate more among the project partners has been followed and more joint work was finally presented.

c. Beneficiaries' roles

*Give an assessment of the role and contribution of each individual beneficiary and indicate if there is any evidence of underperformance, lack of commitment or change of interest.*

Each of the partners has successfully achieved their respective assignments.

## 5. USE AND DISSEMINATION OF FOREGROUND

### a. Impact

*Is there evidence that the project has so far had, and is it likely to have, significant scientific, technical, commercial, social or environmental impact (where applicable)?*

The project has achieved several scientific insights, and some works have got relevant repercussion in media. For instance, the multi-cultural analysis of Wikipedia has been highlighted by Guardian, Washington post, EC CORDIS and other press of about 20 countries. However, technical and commercial impact has not yet been sufficiently developed.

### b. Use of results

*Comment on whether the plan for the use of foreground, including any updates, is still appropriate. Comment also on the plan for the exploitation and use of foreground for the consortium as a whole, or for individual beneficiaries or groups of beneficiaries, and its progress to date.*

The research plan is appropriate. However, exploitation plans have not been sufficiently developed.

### c. Dissemination

*Assess whether the dissemination of project results and information (via the project website, publications, conferences, etc.) has been adequate and appropriate.*

Dissemination activities are well achieved from an academic viewpoint (i.e., publications in peer-reviewed scientific journals and conferences). The coordinator of the project has attempted to draw the attention of banks and other economic national as well as European institutions to the developed NADINE tools (in particular, tools for unraveling hidden correlations). Due to the security restrictions, and perhaps, conservatism of financial institutions, this endeavor turned out to be still unsuccessful.

### d. Involvement of potential users and stakeholders

*Indicate whether potential users and other stakeholders (outside the consortium) are suitably involved (if applicable).*

One European SME, called Nomao ([www.nomao.com](http://www.nomao.com)), was collaborating with the project partners but this collaboration stopped. According to the final presentation of the project (dr Andras Benczur's review), some Hungarian-based SME are seriously interested in establishing collaboration based on the results of NADINE.

### e. Links with other projects and programmes

*Comment on the consortium's interaction with other related Framework Programme projects and other national/international R&D programmes and standardisation bodies (if relevant).*

The Consortium's interaction with other related Framework Programme projects and other national/international R&D programmes has not been sufficiently developed.



## 6. OTHER ISSUES

*If applicable, comment on whether other relevant issues (e.g. ethical issues, policy/regulatory issues, safety issues) have been handled appropriately.*

None.

Name(s) of expert(s):

Maciej A. Nowak

Juan Pavón

Piet Van Mieghem

Date:

10 July 2015

Signature(s):

A handwritten signature in blue ink, appearing to read 'Maciej A. Nowak', is written on a white rectangular background.