

# **COST Action**

## **Final Assessment Review**

### **CM1303: Systems Biocatalysis** **(20/11/2013 to 19/11/2017)**

This report is submitted by the Action Rapporteur in fulfilment of the requirements of the rules for COST Action Management, Monitoring and Final Assessment and is confidential to the COST Association and the Management Committee of the Action.

## Summaries

### Main aim/ objective

The main objective of the Action is to build up a scientific platform to design and construct optimized modular biocatalytic systems for the sustainable synthesis of valuable products.

### The Action addressed this as described below

The MC since the beginning of the Action has taken decisions which have been orienting the whole activity. Thus WG with competences in complementary domains are intended to work together. No funds have been allocated for WG meetings disconnected from a scientific meeting of general interest. This decision has favoured continuous integration between groups and among the participants. No Action meeting isolated from an international high level congress have been organised. COST participants have gathered according to the COST rules and have partially supported conferences on topics central for the Action: Novel enzymes (Gent and Groningen), Multi-step enzyme catalysed reactions (Madrid) Oxidative biocatalysis (Wageningen) continuous flow reactors (Opatija, Bled) Biotrans (Vienna and Budapest). Support for participation to these events has been offered to selected active participants with a particular attention to all the inclusiveness principles and ITC. As a consequence of this policy a strong integration with the scientific community has been developed with obvious dissemination both of COST and of SysBiotat. Moreover the ESI participants have had the opportunity to interact with an open qualified audience larger and reacher than the Action family. Each WG leader has offered access to knowledge, techniques, apparatus, software. What kind of collaboration has been set up and how ESIs have been moving appears from the joint papers gathered in this report and in the STSMs stories published on the website (<http://cost-sysbiocat.fkit.hr/stsm.html>)

### The Rapporteur summarised the Action's major outcomes, impacts and successes as follows

The Action has made good progress since 2013 towards the overall goal of the design and construction of optimized modular biocatalytic systems for the sustainable synthesis of valuable products. The majority of the objectives set out were achieved as evidenced by the 73 publications from two or more Action participants from two different countries. Some of the more ambitious objectives are yet to be fully accomplished, such as "improved mutagenesis strategies for debottlenecking enzyme modules from the systems perspective", however as more systems are developed efforts in this area could intensify. The Action also has received funding for five projects totally 24M€.

The Action has delivered process conditions allowing successive catalytic steps in the same reactor without purification. Within the next two years the Action expects that it will deliver multi-step enzymatic synthesis of valuable products, optimised enzymes and also bring together new enzymes to create new molecules.

A number of international conferences have been partially supported by the Action in research areas important to progress in the Action field including Novel Enzymes, Multi-step enzyme catalysed reactions, oxidative biocatalysis and continuous flow reactors. The Action has supported ESI and has been inclusive and welcomed participation from ITC. Additionally, a number of STSMs have taken place that are excellent methods of training and knowledge sharing.

## Achievement of MoU objectives, deliverables and additional outputs/ achievements

### MoU objectives

The Action reported the achievement of the following objectives and their dependence on the Action networking.

MoU objective	Level of achievement reported by Action	Dependence reported by Action	Dependence assessed by Rapporteur
develop methods for creating enzyme modules with novel functions to establish a plug-and-play toolbox concept	76 - 100%	High	High
develop the assembly of biocatalytic modules from the toolbox to create novel artificial metabolic pathways in vitro	76 - 100%	High	High
develop enzyme modules with new/modified/improved substrate tolerance from the systems perspective	51 - 75%	High	Medium
develop a better understanding of regulation of enzyme function, to avoid inhibition in optimized modules	51 - 75%	Low	Low
develop systems approaches to cofactor-dependent biocatalysis by new/improved/cofactor-independent biocatalysts	76 - 100%	Low	Low
develop standardized interfaces between important standard enzyme modules	26 - 50%	High	Medium
develop improved expression systems for biocatalytic modules	76 - 100%	High	High
develop improved mutagenesis strategies for debottlenecking enzyme modules from the systems perspective	26 - 50%	Medium	Medium
develop smart assay concepts for high-throughput screening of enzyme function	76 - 100%	High	High
develop improved reaction technology, devices for flow synthesis and in situ reaction monitoring	76 - 100%	High	High
identify useful reaction sequences	76 - 100%	High	High
optimize enzyme performance by directed evolution	76 - 100%	High	High
engineer non-natural enzyme reactivity	76 - 100%	High	High
design and optimize multistep artificial bio-synthetic pathways in vitro	76 - 100%	High	High
assemble optimized modules in a plug-and-play fashion for specific synthetic targets	76 - 100%	High	High
apply process engineering and intensification tools for competitive applications	76 - 100%	High	High

Dependence = dependence of the achievement (of each MoU objective) on the Action networking.

### Rapporteur assessment of the achievement of MoU objectives that the Action reported as achieved (76-100%)

The Action did achieve all the above objectives that it reported were more than 75% achieved.

### Action explanation regarding MoU objectives reported as not fully achieved (less than 76%)

The table below shows the Action's explanation and the Rapporteur's analysis thereof for any MoU objectives that the Action reported as not fully achieved.

MoU Objective that was reported as not fully achieved	Action's explanation	Rapporteur's analysis
develop enzyme modules with new/modified/improved substrate tolerance from the systems perspective	Results in the field are connected with publications and talks in the next box. However the specific goal of addressing substrate tolerance sometimes is addressed after other important features of the protein have been established.	The substrate tolerance has been assessed in some of the publications, however this was not the main goal of the work. The objective has partially been achieved.
develop a better understanding of regulation of enzyme function, to avoid inhibition in optimized modules	there are not enough examples of studied optimised modules to understand regulation and avoid inhibition	Further examples of optimised systems are required to develop a better understanding and avoid problems with inhibition. Publications describing optimisation of processes would aid a better understanding of regulation and inhibition.
develop standardized interfaces between important standard enzyme modules	The problem can be addressed entirely only at a higher stage of understanding and organising enzyme modules	More systems need to be assessed before standard methods can be introduced. The justification is fair.
develop improved mutagenesis strategies for debottlenecking enzyme modules from the systems perspective	The objective has remained too far from the actual development of mutagenesis strategies	Objective briefly discussed at Biotrans 2015, but this remains a challenge

### General Assessment of MoU objectives

The level of ambition of the MoU objectives was **Medium**  
Overall, **the Action achieved most MoU Objectives.**

## Deliverables

### Delivery and level of dependence of deliverables reported by Action

Deliverable	Timing deliverable	Dependence reported by Action*
New Metabolisms: Newly designed reaction sequences going beyond the single-enzyme catalyzed step for the synthesis of valuable products.	<b>Not delivered, but foreseen within 2 years</b>	<b>High</b>
Best Biocatalysts: Proteins with required and complementary catalytic functions obtained from directed evolution techniques optimized towards substrates loading, solvent tolerance, broadened pH and T range with as high as possible specific activity.	<b>Not delivered, but foreseen within 2 years</b>	<b>High</b>
Engineered Bioprocesses: Process conditions allowing successive catalytic steps to occur in the same reactor or in successive regions of a continuous reactor without product isolation, solvent removal, and purification.	<b>Delivered</b>	<b>High</b>
Novel enzyme modules, new reaction systems, new molecules and new tools in multistep enzyme catalyzed reactions	<b>Not delivered, but foreseen within 2 years</b>	<b>High</b>

\* Dependence reported by Action = the extent to which the delivery of the deliverable was dependent on the Action networking

### Analysis of level of delivery of deliverables

The level of delivery of the deliverables reported above is assessed as follows.

The Action states that it has delivered Engineered Bioprocesses: Process conditions allowing successive catalytic steps to occur in the same reactor or in successive regions of a continuous reactor without product isolation, solvent removal, and purification. A number of publications indicate that sequential enzymatic reactions in one pot have been achieved. All other deliverables are foreseen within two years. Steps have been made and evidence provided towards these goals, the deliverables should be achievable within 2 years with continued efforts and support.

- Analysis of deliverables reported by the Action as delivered

The deliverables that the Action reported as delivered are confirmed.

- Analysis of deliverables reported by the Action as not delivered but delivery foreseen within 2 years

Deliverable	Plans to ensure delivery within two years
New Metabolisms: Newly designed reaction sequences going beyond the single-enzyme catalyzed step for the synthesis of valuable products.	This is a goal of the whole project and continuous progress are being made. However we believe that a generalised approach to new metabolism is still to be reached.
Deliverable	Plans to ensure delivery within two years
Best Biocatalysts: Proteins with required and complementary catalytic functions obtained from directed evolution techniques optimized towards substrates loading, solvent tolerance, broadened pH and T range with as high as possible specific activity.	The advancement of protein engineering with a whole set of approaches is really within reach. The obtainment of what is defined above as "best catalyst" is near, but to combine all the indicated properties is probably not realistic. We consider however that if not best, many enzymatic catalysts studied are excellent and much improved if compared with a few years ago. Typically amine

	forming enzymes
<b>Deliverable</b>	<b>Plans to ensure delivery within two years</b>
Novel enzyme modules, new reaction systems, new molecules and new tools in multistep enzyme catalyzed reactions	The objective is within reach. A time of a few years ca be considered as a realistic time scale to fullfill the goal

The plans described by the Action to ensure the delivery within two years are credible.

- Analysis of deliverables reported by Action as not delivered and delivery not foreseen

The Action did not report any deliverables as not delivered and delivery not foreseen.

- Analysis of the level of dependence on the Action networking of the achievement of the deliverables

The dependence on the Action networking of the achievement of the deliverables reported by the Action is confirmed

## General Assessment of deliverables

The level of ambition of the deliverables was **high**  
Overall, **the Action achieved some mou objectives**

## Additional outputs / achievements

### Co-authored Action publications

The Action reported 73 publications on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action, and for which the Action networking was necessary. The full list of publications appears in Annex I.

Action networking was necessary for ALL of the listed publications

The:

- quality of the Action's co-authored publications is good.  
A few of the publications are in high impact, journals such as Angewandte Chemie. The majority are in more specialised journals.
- significance of the Action's co-authored publications is good.  
The Action has co-authored works that will provide the basis for further development
- relevance to the Action of the Action's co-authored publications is excellent.  
All publications listed are relevant to the Action
- quantity of the Action's co-authored publications is excellent.  
73 publications have been listed with at least two action participants

### Projects and proposals resulting from Action activities

The Action reported the following projects resulting from Action activities involving at least one Action participant, and for which the Action networking was necessary.

Title	Main proposer name	Funder
ROBOX	Nicholas Turner	H2020
Carbazymes	W.-D. Fessner	H2020
Nanoscale Enzyme Immobilization and Microfluidics for Systems Biocatalysis	Laszlo Poppe	Trans-national - Romanian Ministry for European Funds, through the National Authority for Scientific Research and Innovation (ANCSI) and co-funded by the European Regional Development Fund, Competitiveness Operational Program 2014-2020 (POC), Priority axis 1, Action 1
MIO-enzyme-based multistep syntheses in continuous-flow microfluidic reactor systems	Laszlo Poppe	Trans-national - Bilateral (Hungary-Slovenia) project
Tralaminol -- Enzyme platform for the synthesis of chiral aminoalcohols	W.-D. Fessner	Trans-national - ERA CoBioTech

In addition the Action reported 0 proposals resulting from Action activities involving at least one Action participant, and for which the Action networking was necessary.

Relevance of the Action's proposals and/ or projects is **excellent**

Quantity of the Action's proposals and/ or projects is **very good**

Action networking was necessary for ALL of the listed proposals / projects

## Other Outputs / Achievements

The table below shows the other outputs / achievements and level of dependence on the Action networking reported by the Action and the Rapporteur's assessment thereof.

Other Output / Achievement reported by Action	Dependence reported by Action	Dependence assessed by Rapporteur
<p><b>Research gate project:</b> A new Systems Biocatalysis project webtool has been created for dissemination of the scientific results of the Action, and to support diffusion of COST Action not only among the over 300 scientists which have been involved in SysBiocat but also with the global scientific community. It is a communication tool for connecting the COST Action collaborators, who can make their research results rapidly visible by individually entering or linking their publications, presentations, posters, data etc. to the COST Action Systems Biocatalysis. The project tool can be easily accessed at the website <a href="https://www.researchgate.net/project/Systems-Biocatalysis">https://www.researchgate.net/project/Systems-Biocatalysis</a>, whereby access for reading is open globally and writing is available for the collaborators of the COST Action Systems Biocatalysis. In the few month from its constitution the webtool has collecte almost 2000 reads.</p>	<p><b>High</b></p>	<p><b>High</b></p>

The quality, quantity and dependence (on the Action networking) of the other outputs/ achievements was assessed as follows.

The research gate systems biocatalysis project page is an excellent additional output which allows everyone to see the latest publications from the project.

## Assessment of additional outputs and achievements (including co-authored publications and proposals/ projects)

The level of ambition of additional outputs and achievements was **high**.  
Overall, **the Action achieved > 4 valid Additional Outputs / Achievements**.

## General Assessment

The Action's outputs and achievements are **good**.

## Impacts

The Action reported the following impacts (the short- to long-term scientific, technological, and / or socioeconomic changes produced by a COST Action, directly or indirectly, intended or unintended) that have resulted, or might result, from the Action.

Description of the impact	Type of impact	Timing of impact
<p><b>Access to purified proteins with well defined purity and properties.</b> Systems Biocatalysis aims at the formation of reaction networks in which series of events are triggered from a series of specific enzymes. The recent advances in protein engineering have made possible to give for granted the availability of (almost) any enzymatic activity. This requires the leading orientation of specialized laboratories and skills not usually present in synthetic laboratories where the synthetic sequence and the synthetic strategies are mostly addressed. The Action has allowed to connect the enzyme producing centers with the more synthetically oriented ones. This simplified approach from one side will become established in ESI being educated to consider biocatalytic tools as real competitors of organic solvent chemistry. At the same time will help to modify industrial processes forcing to evaluate the economics and ecological aspects of enzyme catalysis.</p>	<ul style="list-style-type: none"> <li>• Scientific / Technological</li> <li>• Economic</li> <li>• Societal</li> </ul>	Achieved
<p>Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action: Access to purified proteins with well defined properties can provide biocatalysts with improved selectivity and alternative approaches to traditional synthetic chemistry which can lack specificity leading to bi-products and the use of deleterious solvents. The use of enzymes in productions of chemical is potentially cleaner, more efficient and cheaper.</p>		
<p>Identify possible enzyme catalysed synthetic reaction sequences with an adaptation of the concept of the traditional retro-synthetic approach. The retro-synthetic approach to design the way reactants ==&gt; products considers for each step the available reagent tool from the whole of the known instruments. In replacing chemical steps with enzyme catalysed ones, the reaction sequence might be sensibly or completely different. The Action results on this field are exemplified by the enormous improvement in amine and lactones formation employing advanced preparation of new modified aminotransferases, imine reductases, Bayer-Villigerases among others. Moreover enzymes previously considered as strictly dependent from cofactors and well defined reaction conditions and medium are in the process of being modified by genetic engineering to more generalistic and easy to use biocatalysts. The new way of designing reaction sequences will at large influence the economic and societal aspects of organic synthesis.</p>	<ul style="list-style-type: none"> <li>• Scientific / Technological</li> <li>• Economic</li> <li>• Societal</li> </ul>	Achieved
<p>Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action: A retro-synthetic approach utilising enzymes is an excellent method to develop new routes products of industrial importance such as pharmaceuticals and agrochemicals. The Action has contributed to bringing enzymatic pathways together and is making progress towards improved enzymes.</p>		
<p>Process intensification: continuous flow reactor can be applied in multi-step enzyme catalysed reaction sequences going beyond enzyme immobilisation and compartmentalisation. The activity occurs at different level acting on enzyme immobilization: novel</p>	<ul style="list-style-type: none"> <li>• Scientific / Technological</li> <li>• Economic</li> </ul>	Foreseen within two years

immobilization methods especially suitable for continuous flow systems (nanoparticles, electrospinning, monolith systems, magnetic biocatalysts). Flow systems: Novel continuous flow mini and microreactors (e.g. microreactor chips, membrane reactors, monolith reactors, disc reactors) for consecutive enzymic and/or chemical steps; Miniaturization and integration with downstream and process monitoring elements in a single continuous flow system. The progress in miniaturization in continuous systems is parallel to what is actually happening in non-enzyme catalysed processes already reaching the industrial scale. It is expected that also in the case on enzymatic catalysis the same level of efficiency will be reached.

Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action:  
Flow systems which remove the need for process downtime and workup steps can greatly increase outputs in industry and will provide further improved process compared to batch systems.

The extent to which the Action has advanced the careers, skills and networks of researchers including ECIs (as described by the Action) is very good.

## General assessment of impacts

The Action's impacts are best described as follows.  
Multiple highly significant impacts are reasonably foreseen for the future OR one highly or moderately significant impact is already observed [Very Good]

## Dissemination and exploitation of Action results (other than co-authored Action publications listed previously)

### Dissemination meetings funded by the Action

#### Action website

<http://cost-sysbiocat.fkit.hr/>

The:

- openness and user-friendliness of the Action website are excellent
- content of the Action website (programmes and minutes of all events present, all outputs/deliverables accessible from website) is very good

The Action website was an effective means of disseminating the Action.

#### Other dissemination activities

The following other dissemination activities reported by the Action were effective and added value

<b>Item/activity</b>	W.D. Fessner (DE) Systems Biocatalysis: back to the future. Symposium: Systems Biocatalysis for Asymmetric synthesis Concepts, challenges and Rewards, Darmstadt October 23rd 2015 Seminar centered on the Scientific significance of SysBiocat
<b>Target Audience</b>	Scientific audience composed of senior scientist from German chemical companies, graduate students, academics from Darmstadt University
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://carbzymes.com/news-and-events/news?start=15">http://carbzymes.com/news-and-events/news?start=15</a>

<b>Item/activity</b>	Symposium: Systems Biocatalysis for Asymmetric synthesis Concepts, challenges and Rewards, Darmstadt October 23rd 2015 Seminar centered on the Scientific significance of SysBiocat L. Hecquet FR Carboligation reaction by trankeolase: from past to present challenges
<b>Target Audience</b>	Scientific audience composed of senior scientist from German chemical companies, graduate students, academics from Darmstadt University
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://carbzymes.com/news-and-events/news?start=15">http://carbzymes.com/news-and-events/news?start=15</a>

<b>Item/activity</b>	Symposium: Systems Biocatalysis for Asymmetric synthesis Concepts, challenges and Rewards, Darmstadt October 23rd 2015 Seminar centered on the Scientific significance of SysBiocat N. Turner UK Biocatalytic retrosynthesis: working back from the answer
<b>Target Audience</b>	Scientific audience composed of senior scientist from German chemical companies, graduate students, academics from Darmstadt University
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://carbzymes.com/news-and-events/news?start=15">http://carbzymes.com/news-and-events/news?start=15</a>

<b>Item/activity</b>	Symposium: Systems Biocatalysis for Asymmetric synthesis Concepts, challenges and Rewards, Darmstadt October 23rd 2015. Seminar centered on the Scientific significance of SysBiocat. S. Servi IT Metabolic like reaction sequences in Systems Biocatalysis
<b>Target Audience</b>	Scientific audience composed of senior scientist from German chemical companies, graduate students, academics from Darmstadt University
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://carbazymes.com/news-and-events/news?start=15">http://carbazymes.com/news-and-events/news?start=15</a>

<b>Item/activity</b>	Symposium: Systems Biocatalysis for Asymmetric synthesis Concepts, challenges and Rewards, Darmstadt October 23rd 2015. Seminar centered on the Scientific significance of SysBiocat P. Clapès (ES) Substrate promiscuity of aldolases by minimalist active site redesign
<b>Target Audience</b>	Scientific audience composed of senior scientist from German chemical companies, graduate students, academics from Darmstadt University
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://carbazymes.com/news-and-events/news?start=15">http://carbazymes.com/news-and-events/news?start=15</a>

<b>Item/activity</b>	Conference by W.Kroutil (AT) at Emory University, Atlanta, USA, September 2, 2015
<b>Target Audience</b>	Graduate students, academics of the Emory university
<b>Outcome of the activity</b>	Raise the attention on the Systems Biocatalysis approach and at the European funding institution (COST)
<b>Hyperlink</b>	none

<b>Item/activity</b>	W.Kroutil AT : Biotrans award lecture at Biotrans '15 in Vienna
<b>Target Audience</b>	The largest community ever gathered in biocatalysis, over 600 scientists from all over the world
<b>Outcome of the activity</b>	A compendium of a (young) life achievement with particular focus on Systems Biocatalysis
<b>Hyperlink</b>	<a href="http://biotrans2015.book-of-abstracts.com/programme/confirmed-oral-presentations/">http://biotrans2015.book-of-abstracts.com/programme/confirmed-oral-presentations/</a>

<b>Item/activity</b>	Conference by W.Kroutil AT et al. Asymmetric Pictet-Spengler Reaction via Strictosidine Synthases to Access Tetrahydro- $\beta$ -carboline - Protein Expression and Substrate Scope Austrian Chemistry Days, Innsbruck, Austria, September 21, 2015.
<b>Target Audience</b>	Meeting of the Austrian Chemical Society
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://www.chemietage.at">http://www.chemietage.at</a>

<b>Item/activity</b>	Conference by W.Kroutil AT et al. Biocatalytic oxidation and C-C bond formation Seminar at Merck & Co., Inc., Rahway, USA, August 31, 2015.
<b>Target Audience</b>	Scientific audience composed of senior scientist from Merck corporation
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	not available

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<b>Item/activity</b>	Conference by W.Kroutil (AT) Biocatalysts and organic synthesis Seminar at the California Institute of Technology (CalTech), Pasadena, USA, August 18, 2015
<b>Target Audience</b>	Scientific audience composed of graduate students, academics from CALTECh and senior scientists of local chemical companies
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	not available

<b>Item/activity</b>	Presentation by M. Tudorache (RO) "Tuning the bio-polymer properties based on lignin residues and biocatalytic process" 12th International Conference on Renewable Resources & Biorefineries, Gent, Belgium, May-Jyne, 2016
<b>Target Audience</b>	The conference audience
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	not available

<b>Item/activity</b>	Presentation by M. Tudorache RO Guideline Of Alpha-Pinene To Value-Added Products Using Biocatalytic Tools", Third International Conference Catalysis For Renewable Sources: Fuel, Energy, Chemicals, Catania, Sicily, 2015
<b>Target Audience</b>	The conference audience
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	not available

<b>Item/activity</b>	F. Rudroff / TU Wien, Vienna, Austria CATALYTIC CASCADES – 'EN ROUTE' TO APPLIED BIOCHEMICAL CELL-FACTORIES Monday, 2017-09-25, Austrian Chemistry Days, Salzburg, (AT)
<b>Target Audience</b>	Austrian Chemical Society
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://www.chemietage.at/index.php?id=1708">http://www.chemietage.at/index.php?id=1708</a>

<b>Item/activity</b>	M.D. Mihovilovic / TU Wien, Vienna, Austria FLAVOENZYME BIOCATALYSIS – CHALLENGES AND OPPORTUNITIES Austrian Chemistry days, Monday, 2017-09-25, Salzburg, (AT)
<b>Target Audience</b>	Austrian Chemical Society
<b>Outcome of the activity</b>	Highlight on the methods of Systems Biocatalysis and on the tools provided by COST Actions
<b>Hyperlink</b>	<a href="http://www.chemietage.at/index.php?id=1708">http://www.chemietage.at/index.php?id=1708</a>

<b>Item/activity</b>	Horizon 2020 Summer School 2017 Biocatalysis as a Key Enabling Technology
<b>Target Audience</b>	ESI from COST Countries
<b>Outcome of the activity</b>	10 ESI from CM1303 have participated to the workshop held in Siena 3-7 October 2017 funded by the ITC Conference Grant
<b>Hyperlink</b>	<a href="http://cost-sysbiocat.fkit.hr/report/CORDIS_project_Carbazymes.pdf">http://cost-sysbiocat.fkit.hr/report/CORDIS_project_Carbazymes.pdf</a>

## Exploitation activities

### Assessment of Action dissemination and exploitation

The effectiveness of the Action's dissemination and exploitation approach (other than co-authored publications) is assessed as follows:

The Action has a user friendly website that allows access to the majority of the information about the action without password requirements. The Action has also set up a Researchgate project page which appears to be thriving. The work of the Action has been disseminated across the world to scientists from both academia and industry and at all career levels. 24M€ funding has been award to Action participants which displays the success of the Action.

Assessment of Action dissemination and exploitation activities:

All Action activities focusing on dissemination of Action results were effective [Very Good]  
Most Action activities focusing on exploitation of Action results were effective [Good]

## Action Success(es)

The following table shows the success(es) reported by the Action and the Action Rapporteur's comment.

Success reported by Action	Action Rapporteur comment
<p>Numbers: 4 projects started and financed to CM1303 SysBiocat members in the Action period gathering almost 25.000.000 euro. Coordinators belong to WG 1, WG3 and WG5 71 publications authored by at least 2 Cost members from different Countries with an average IF of 5.5 (see this report). 57 additional publications acknowledging SysBiocat and relevant for the Action success <a href="http://cost-sysbiocat.fkit.hr/publications.html">http://cost-sysbiocat.fkit.hr/publications.html</a> 38 lectures at Biotrans 2015 Vienna + 2017 Budapest <a href="http://cost-sysbiocat.fkit.hr/PR2/meeting_programs.html">http://cost-sysbiocat.fkit.hr/PR2/meeting_programs.html</a> 200 posters presented in workshops, meeting, 66 STSMs + conf grants (<a href="http://cost-sysbiocat.fkit.hr/stsm.html">http://cost-sysbiocat.fkit.hr/stsm.html</a>) budget 130.000 ( 25 % of the budget) Trainee composition: Gender M 37 (10 from ITC) F 29 (20 from ITC) Schools budget 90.000 (15 % of budget). on total expenditures M / F = 51 / 49 ESI participation to Activities has been globally of 40%, mainly in STSMs and TS on total expenditures ITC = 38% Total 350 supported in different forms. I believe that these numbers accompanied by the quality of the research should speak of a very successfull Action</p>	<p>The Action has been very successful bringing together participants, both male and female, from ITC. A few high impact publications have been produced along with successful grant applications for new projects. Overall the Action has been a great success.</p>
<p>Providing access to european excellence centres in biotechnology. Within the promoters of the Action are present laboratories which can be considered as expressing excellence on several topics, and not only at the european level. The exchange of ESI has allowed young researchers from ITC but not only (40:60 %) to have the possibility to enter the sanctuary and eventually obtain a temporary position for a longer period. This has had a profound effect on the confidence and the relationships of ESI with senior scientists and among themselves. A great mix. These is the social educational aspects. As a fundamental complement the deep research carried out on protein engineering and the innovation in metabolic like pathways design adds quality to the scientific aspect.</p>	<p>ESI exchanges are an excellent method to develop and share skills and encourage the next generation of leading investigators.</p>

## Other matters

### Difficulties in implementing the Action

The Action Rapporteur did not report having observed any difficulties in the implementation of the Action.

### Suggestions for improvements to COST framework / procedures

The Action Rapporteur did not suggest any changes to the COST framework .

### Emerging topics / developments in the field of the Action

The Action reported the following emerging topics / developments in the field of the Action.

- The Action has not depleted the objective of the initial project. Many Colleagues believe that a continuation of the Action as it is could be beneficial. Given for granted that COST policy does not consider this event it is a rather common point in our community that being enzymes central to the all project, the discovery of Novel Enzymes, proteins with complementary activity to the one known or able to catalyse new reactive events, deserves a real investment especially in a context like a COST Action.

The Action Rapporteur did not make any comment on the emerging topics / developments in the field reported by the Action.

### Action Rapporteur

This Final Assessment Report was submitted on 2018-02-13 by:  
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## Annex 1: List of publications

The Action reported 0 publication on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action, and for which the Action networking was necessary.