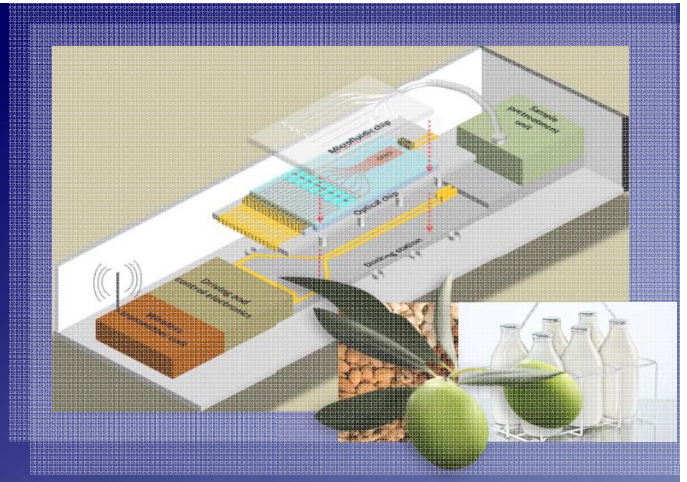
European Commission

MNBS 2014

BIOFOS



Micro-ring resonator-based biophotonic system for food analysis

Funded under the seventh Framework Programme (FP7), ICT- STREP **FP7-ICT-2013-10, GA no: 611528**

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BIOFOS Consortium

Ten (10) Partners (5 EU countries)

National Technical University of Athens	Institute of Communications & Computer Systems/National Technical University of Athens	**ICCS/NTUA**	Greece
LIONIX	Lionix BV	**LIONIX**	Netherlands
csem	CSEM Centre Suisse d'Electronique et de Microtechnique SA	**CSEM**	Switzerland
UPVD Université de Perpignan Via Domitia	Université de Perpignan Via Domitia	**UPVD**	France
BRFAA BIOMEDICAL RESEARCH FOUNDATION ACADEMY OF ATHENS	Biomedical Research Foundation, Academy of Athens	**BRFAA**	Greece
surfix	Surfix BV	**SURFIX**	Netherlands
WAGENINGEN For quality of life	University of Wageningen	**WU**	Netherlands
IRTA RECERCA I TECNOLOGIA AGROALIMENTÀRIES	Institut de Recerca I technologia Agroalimentaries	**IRTA**	Spain
SAXION	Saxion University	**SAXION**	Netherlands
COVAP	Sociedad Cooperativa Andaluza Ganadera del Valle de los Pedroches	**COVAP**	Spain

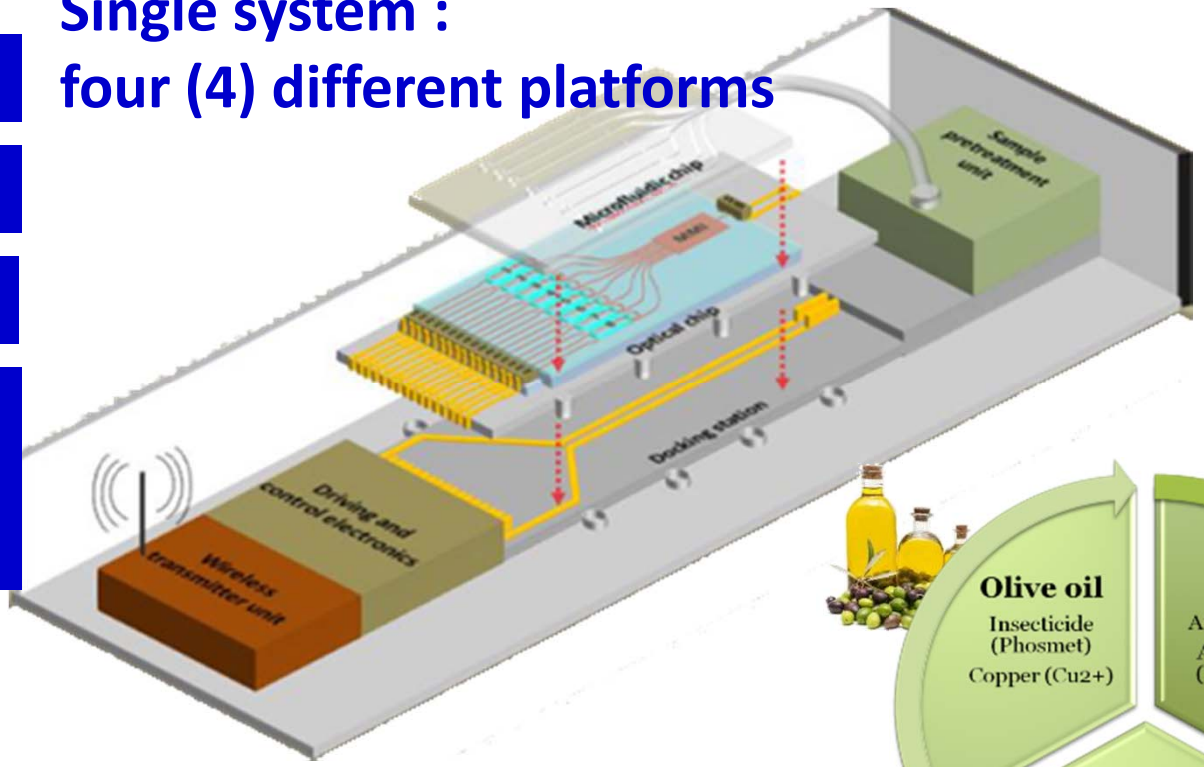
BIOFOS GOAL

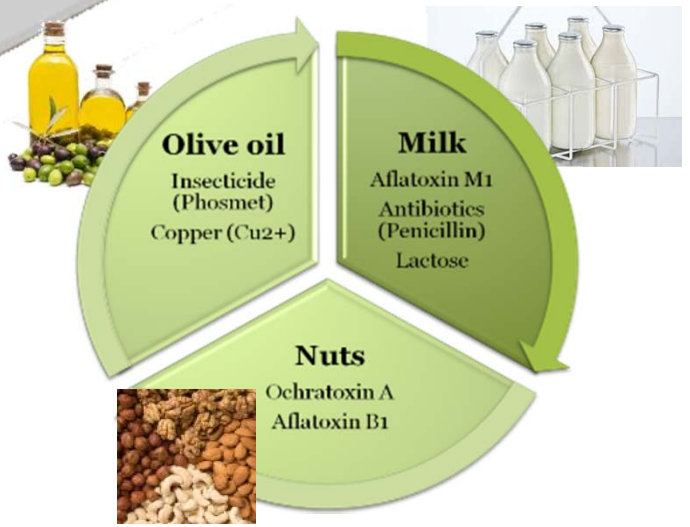
Development of a portable, multi-analyte biosensing platform for real-time/on-site monitoring of food quality.

PLATFORMs

- Opto-chip
- Bio-chip
- Fluidics-chip
- Electronics-system integration

Single system :
four (4) different platforms





BIOFOS: Stakeholders

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Food industry is the second largest sector in the manufacturing industry of EU, consisting of about *310,000 enterprises*, with *4.8 million employees* and **a large network of stakeholders** (production, process and storage of food products).

Stakeholders. Who are they?

Distribution of *"Questionnaires"* - including actual options chosen for BIOFOS device and demands for final users requirements.

Type/role	Examples	Interest/role
▪ **Farmers and their agents**	Land owners, farm workers, unions, farmers' associations	Victims of exposure; risk management and reduction; potential victims/beneficiaries of risk response (e.g. loss of income)
▪ **Agricultural suppliers and services**	Seed suppliers, pesticide manufacturers, fertiliser manufacturers, transport companies	Risk management and reduction; potential victims/beneficiaries of risk response
▪ **Food distributors and processors**	Food wholesalers and retailers, transport companies	Potential victims/beneficiaries of risk response
▪ **National/regional health protection agencies**	Public health institutions, food standards agencies, occupational health and safety agencies, regional health boards and environmental health departments	Risk management and regulation; risk communication
▪ **National/regional environmental protection agencies**	Ministries of environment, environmental regulatory agencies, local authorities	Risk management and regulation
▪ **European and international agencies**	European Commission (Directorates for Agriculture, Environment, Health); WHO, FAO	Risk management and regulation; risk communication
▪ **NGOs**	Pesticide action groups, organic farming groups, animal welfare groups	Risk communication; representatives of victims of exposure; lobbyists for action
▪ **Others**	1) Rural residents; 2) National and local media ; 3) Scientists (epidemiologists, toxicologists, environmental scientists)	1) Victims of exposure; 2) risk communication; 3) risk analysis, risk communication, potential beneficiaries of risk response

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BIOFOS: Stakeholders' needs

Main specifications	Consolidated requirements			Current state of quality control	
Olive oil sector					
Targeted Analytes	*Insecticides*	*Heavy metals*		**Pesticides** Phosmet, clorpyfifos,dimetoat	**Copper**
	Phosmet and Chlorpyrifos*	**Copper ions**			
Detection limit	60 - 200 ppb (in olive oil)	2 – 10 ppb (in oil)			250 µg/kg oil
Cost per sample	**≤ 0.5 €/analysis**			**~ 55 €/sample**	**~ 43 €/sample**
time-to-result	**≤ 5 minutes**			**2 days/set of samples**	**2 days/set of samples**
Nuts sector					
Targeted Analytes	*Mycotoxins*			**Aflatoxin B1(AFB1)**	
	Aflatoxin B1, Ochratoxin A , Aflatoxin B2*, Aflatoxin G1*, Aflatoxin G2*				
Detection limit	1-6 ppb				
Cost per sample	**≤ 0.5 €/analysis**			**15-20 €**	
time-to-result	**≤ 5 minutes**			**2-3 hours/set of samples**	
Milk Sector					
Targeted Analytes	*Mycotoxins*	*Antibiotics*	*Other*	**Kit for antibiotics** (Delvotest SP100)	
	Aflatoxin M1	**Penicillin**, tetracyclines*	**Lactose,** Prostaglandins*		
Detection limit	25 ppb	4 ppb	0.01 %	3-30 ppb (penicillin G), 270 ppb (tetracyclines)	
Cost per sample	**≤ 0.5 €/analysis**			**~22-28 € /25 samples**	
time-to-result	**≤ 5 minutes**			**~ 3 hours**	

**Additional requirements proposed by the corresponding stakeholders.*

Food quality control

Actual fast analysis alternatives

Food system	Toxic analyte	Test name	Test system	Complementary equipment needed
Olive oil 	Only official lab analysis is available			
Nuts and Dried fruits 	Ochratoxin A	Ochra Test	Monoclonal antibodies	Grinder + HPLC
		ROSA Ochratoxin		Grinder + incubator
	Aflatoxin B1	Afla-V		Strip reader
		Alfa Test		Grinder + HPLC
		ROSA WET or BEST		Grinder + incubator
Raw milk 	Antibiotic Broad spectrum	Delvotest_BLF		Incubator
	Antibiotic Narrow spectrum	BetaStar	Receptor-gold particles	Incubator + Reader
		SNAP_Beta-lactamST	Enzyme-linked receptor binding assay	Device + Reader
		Charm_ROSA MRL_Betalactam	Monoclonal-Antibodies	Incubator+Reader
	Aflatoxin M1	SL Aflatoxin M1		
		Aflasensor		
		VICAM		HPLC
Milk	Lactose	Freezing Point	Freezing Point	Cryoscope

Need for effective screening tools that will be simple, fast, low-cost, sensitive, truly reliable and portable for use at food production sites and processing units.

BIOFOS in nuts sector

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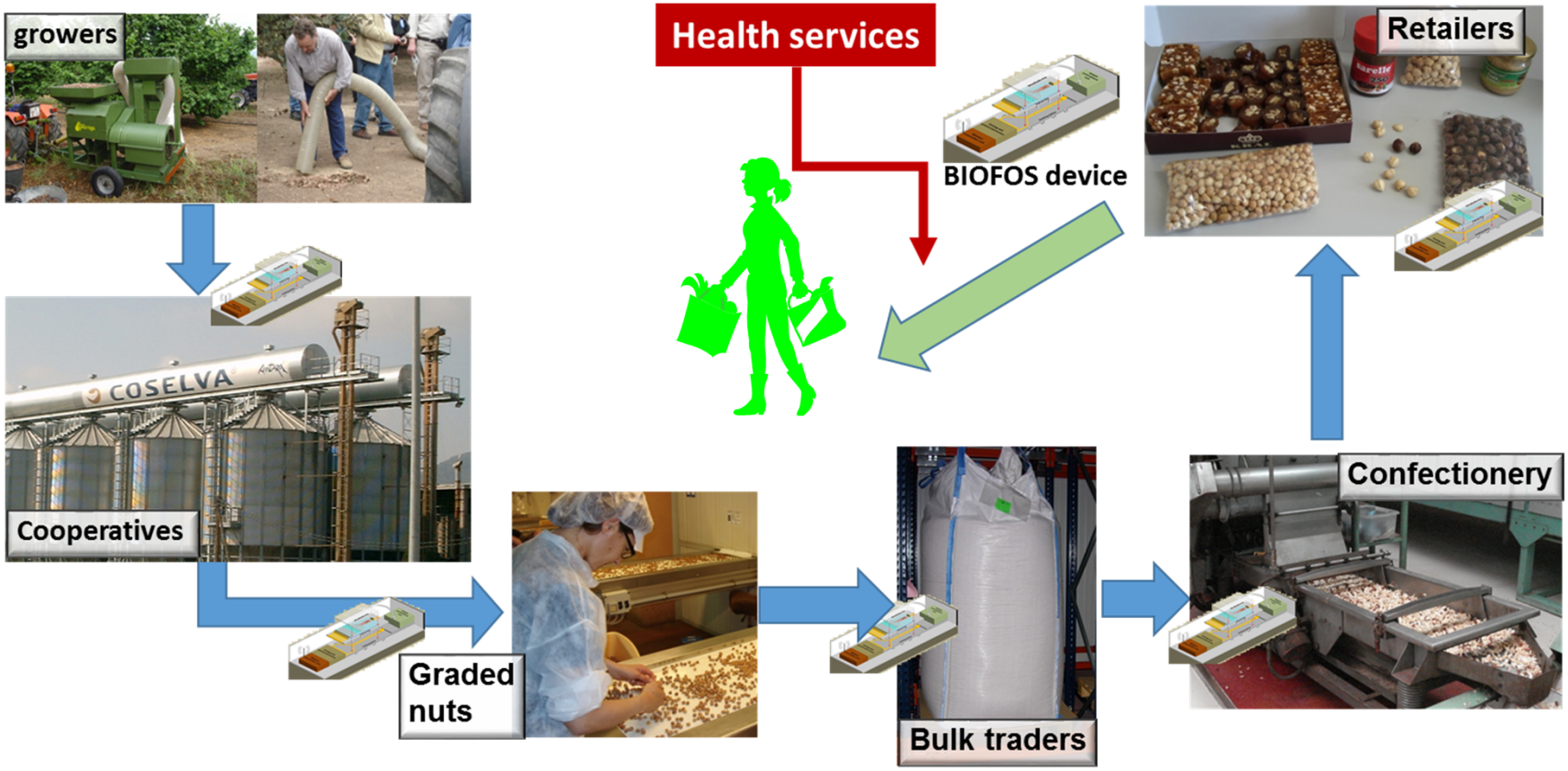

CURRENT ANALYTICAL METHODS

- Considerable technical skills
- Depend on pre-treatments
- Time consuming

Innovations in BIOFOS SYSTEM

- **Smart use**
- **Automated pre-treatment**
- **Fast**

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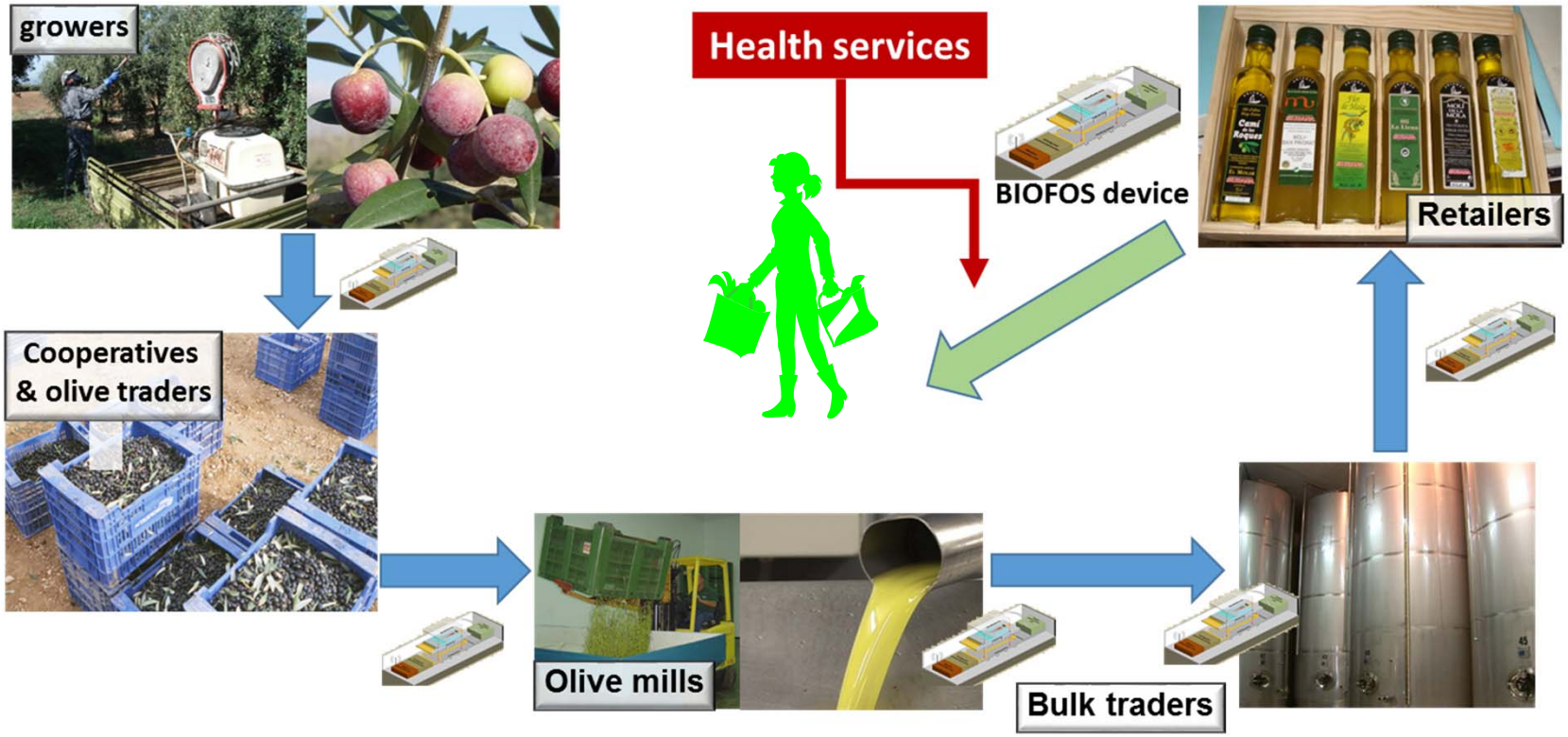
BIOFOS in olive oil sector



CURRENT ANALYTICAL METHODS

- Not portable devices
- Expensive
- High technical skills
- Time consuming

Innovations in BIOFOS SYSTEM

- **Increase the kit lifetime**
- **Multi-analyte**
- **Reduce cost/analysis**
- **Increase practicability in handling**

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BIOFOS in milk sector

AFLATOXINS

FEEDING
Commission Regulation(EC) No 1881/2006

ANTIBIOTICS

MANAGEMENT DAIRY ANIMALS
Residue limits of pharmacologically active substances in foodstuffs of animal origin
Council Regulation (EEC) No 2377/90

MILK COLLECTION

INTERNAL STANDARD
MILK TEMPERATURE/STABILITY

DISCARD

FARM MANAGEMENT

EU REGULATIONS:
SAFETY REGULATIONS
QUALITY REGULATIONS

LACTOSE-FREE PRODUCTS
Regulation (EC) N°1924/20062

LACTOSE-DEPENDING PROCESSES
CHEESE MANUFACTURING
INTERNAL STANDARD

DAIRY PROCESSING INDUSTRIES

INTERNAL STANDARD
Commission Regulation (EC) No 853/2004
Commission Regulation (EC) No 1881/2006

INDUSTRIAL PROCESS CONTROL

CURRENT ANALYTICAL METHODS

- Time-consuming
- Expensive
- Depend on pre-treatments
- Simple analyte testing
- Considerable technical skills

Innovations in BIOFOS SYSTEM

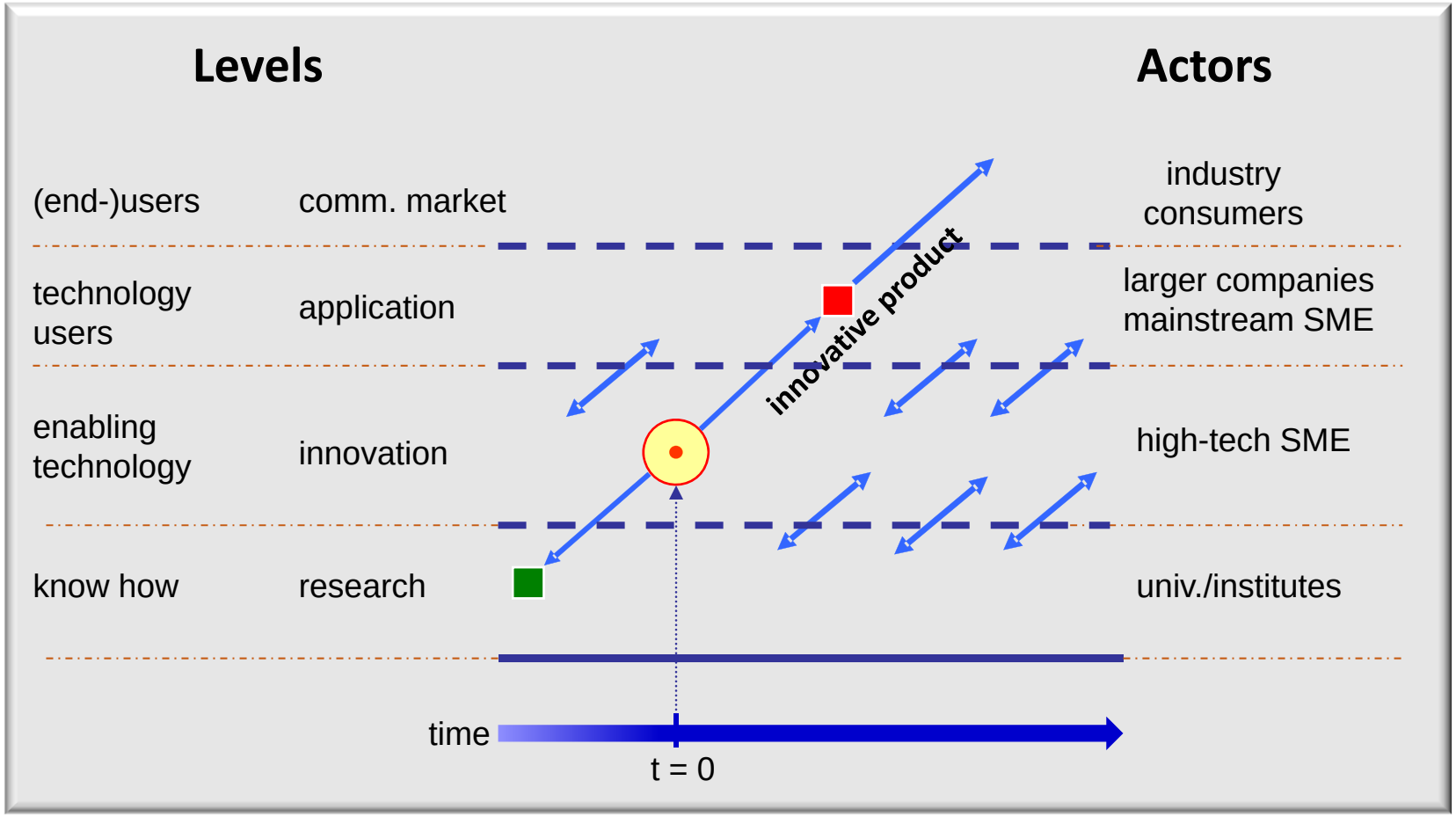
- **Increase the kit lifetime**
- **Multi-analyte**
- **Reduce cost/analysis**
- **Increase practicability in handling**

Innovation of BIOFOS

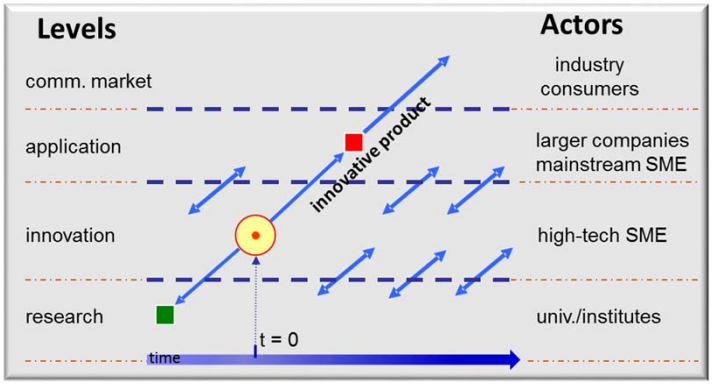
Supply chain	Current analytical methods	Innovations in BIOFOS system
OIL	Not portable devices Expensive High technical skills Time consuming	Portable device Cheaper Smart use Fast
NUTS	Considerable technical skills Depend on pre-treatments Time consuming	Smart use Automated pre-treatment Fast
MILK	Time consuming Expensive Single analyte testing Considerable technical skills Depend on pre-treatments	Increase the kit lifetime Reduce cost per analysis Multianalyte Smart use

Innovation & Road to exploitation

- **Research → Application:** is not a linear, continuous trajectory
- **Innovation takes place at innovation/enabling technology level**



Community building



- **Research → Application:** not a linear, **continuous trajectory**
- **Innovation takes place at innovation/enabling technology level**

Levels	Actors	BioFQS	Candidates
Market	**Industry/consumers**	**COVAP IRTA**	**FrieslandCampina, etc**
Application	**Technology user**	**Not present**	**Burkert, AlfaLaval, etc.**
Innovation	**HT-SME /industrial institutes**	**CSEM LioniX Surfix**	**BioVolt, Scienion, FlexMers, etc**
Research	**Universities /institutes**	**ICCS/NTUA UPVD, BRFAA, WU Saxion**	**ANSES, JRC-IHCP, etc**

Innovation & Road to exploitation

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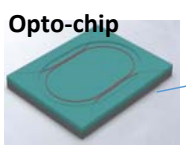
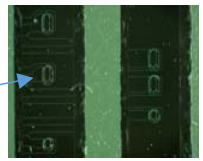
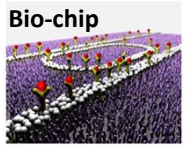
Opto-fluidic chip

Opto-chip

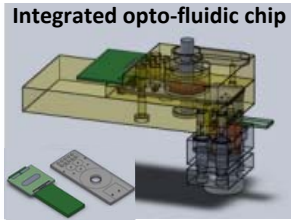




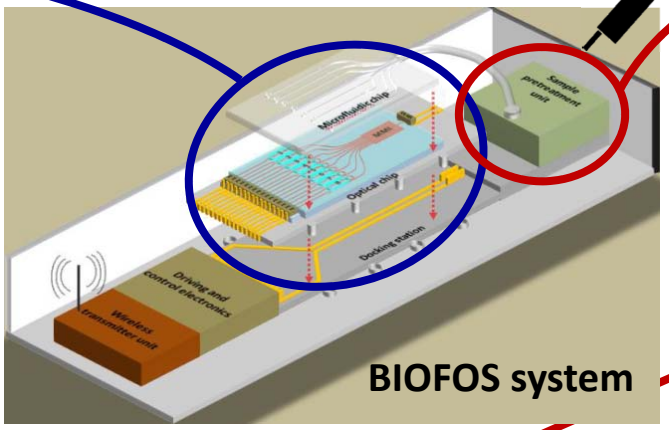
Bio-chip



Integrated opto-fluidic chip



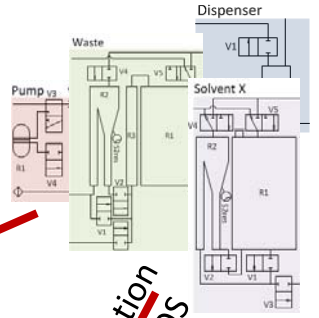
Sample



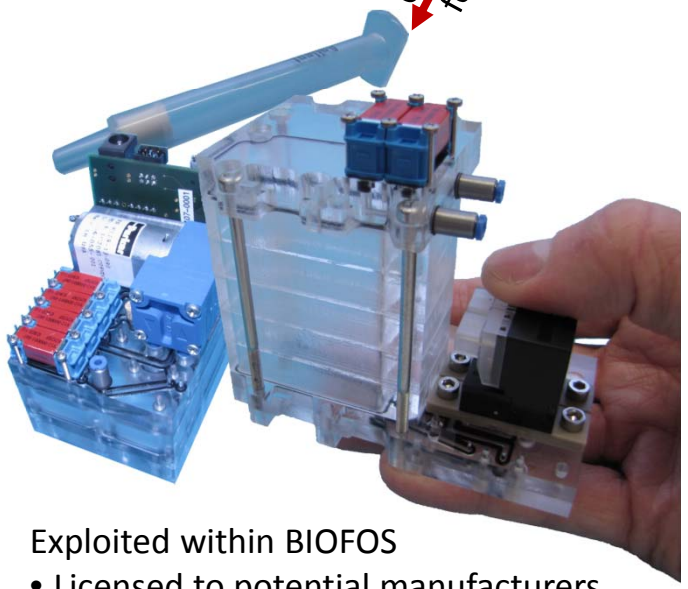
Pretreatment unit

Modular approach

1st innovation



Combination for BIOFOS



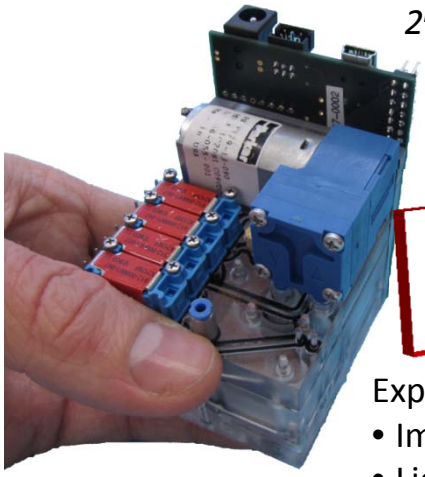
Exploited within BIOFOS

- Licensed to potential manufacturers
- Sold through BIOFOS partner?

Pump module

2nd innovation

Pump module to the market



Patentability check in progress

Exploited through CSEM

- Implemented in other projects of CSEM
- Licensed to potential manufacturers and reseller

BIOFOS IP, Manufacturing, Market

IP

- LioniX TriPleX technology is patented; linked patents in preparation
- Surfix modification technology is patented
- Patents on methods in dedicated instruments (technology user)
- Generic rules on IP in Consortium Agreement
- To be detailed/defined in Innovation Action(s) between relevant partners

Manufacturing

- In principle yes, however to be developed further

Access to the market

- No
- New consortia with actors in application level in Innovation Actions, SME Instrument and Fast Track to Innovation

Innovation & Road to exploitation

- **Business case evaluation Milk**
  - Preliminary conclusion: difficult in present-day MILK value chain.
  - Development of new concepts with sensing/detection as prerequisite.
    - e.g. in MILK: enabling the supply of raw/fresh milk products
    - Mycotoxins/antibiotics as first stepping-stone for demonstration of optofluidics technology in practice.
- **Clustering/Community building required**
- **Funding possibilities in H2020**
  - ICT-28: Cross-cutting ICT KETs, deadline 21-4-2015

    a) Innovation Actions: ICT-KET integrated platforms for the healthcare and food sectors
  - ICT 37 Open Disruptive Innovation Scheme
  - Fast Track to Innovation pilot