Smart4Europe2

Catalysing Digitisation throughout Europe

Deliverable 2.1

Typology of the SAE Community Report

Cover and Control Page of Document	
Project Acronym:	Smart4Europe2
Project Full Name:	Catalysing Digitisation throughout Europe
Grant Agreement No.:	872111
Programme	DT-ICT-01-2019
Instrument:	H2020 - Coordination and Support Action
Start date of project:	01/01/2020
Duration:	24 months
Work Package:	WP6
Associated Task:	Task(s) 2.1
Nature[1]	R
Dissemination Level[2]:	CO
Version:	V1.0
Actual Submission Date :	30/08/2021 (M20)
Contractual Submission Date :	31/08/2021 (M20)
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[1] R=Report, DEC= Websites, patents filling, Ethics, ORDP: Open Research Data Pilot, etc., O=Other

[2] PU = Public, CO = Confidential, only for members of the consortium (including the Commission Services)

Acronyms Listed in Document	
AE	Application Experiments
CLEC	Customized Low Energy Computing Power in CPS and IoT
CPS	Cyber-Physical Systems
DIH	Digital Innovation Hub
FSTP	Financial Support to Third Parties
FWE	Flexible Wearable Electronics
H2020	Horizon 2020
IA	Innovation Action
IoT	Internet of Things
KDT	Key Digital Technology
OLAE	Organic and Large Area Electronics
S4E2	Smart4Europe2
SAE	Smart Anything Everywhere
SSI	Smart System Integration
WP	Work Package
5E	CSA project - https://5e-project.eu/

Version	Date	Changes made	by	Sent to	purpose
0.1	18.08.2021	Initial draft	Isabelle Dor, Jérôme Gavillet	CEA	Draft
0.2	23.08.2021	Update implementing reviews from S2i and HS	Isabelle Dor, Jérôme Gavillet	CEA	Draft
0.3	25.08.2021	Updates by THHINK included	Jerôme Gavillet	S2i	Update
1.0	30.08.2021	Finalisation	Meike Reimann	EC	Submission

Disclaimer

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Smart4Europe2 has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No. 872111.

1 Executive Summary

The typology of Innovation Actions (IAs)/Digital Innovation Hubs (DIHs) launched under the Smart Anything Everywhere initiative (SAE) has been established in terms of,

- DIHs network cohesion
- Stakeholders
- Key Digital Technologies (KDTs)
- Sectors of applications
- Products functionality

Common features across all DIH/IA projects launched in H2020 under *Smart Anything Everywhere* (SAE) were defined, with the help of the project coordinators and representatives, that would serve as a reference towards consolidating future innovation instruments and digital ecosystems.

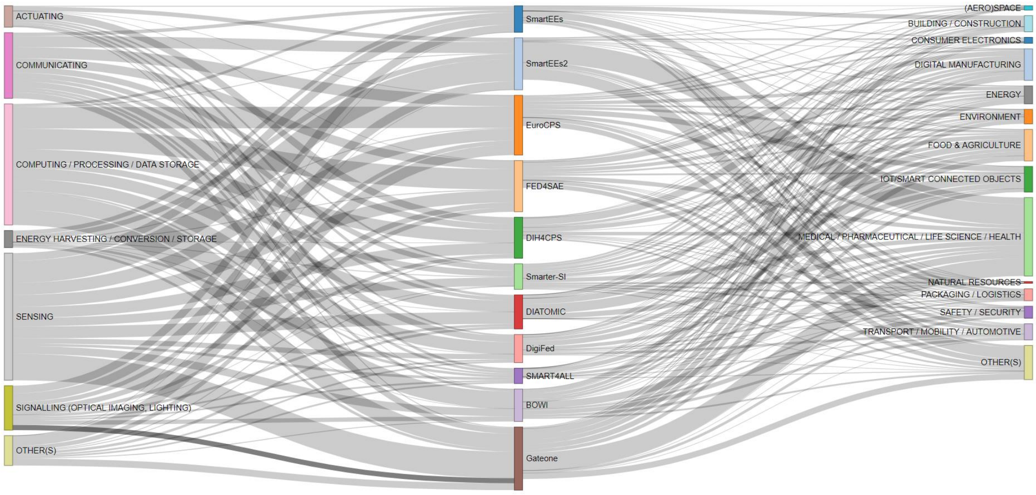
As part of this exercise, a total of 265 Application Experiments have been analysed, originating from 11 DIH/IA projects (14 projects in total were financed under SAE, supporting around 400 Application Experiments with Financial Support to Third Parties (FSTP).

Main results are,

- the mapping of applications and product functionalities addressed in the frame of Application Experiments, highlighting 'hot spots' and suggesting cross-sectorial potential of technologies and technologies complementarity by sectors (Figure 13).

	(AERO)SPACE	BUILDING / CONSTRUCTION	CONSUMER ELECTRONICS	DIGITAL MANUFACTURING	ENERGY	ENVIRONMENT	FOOD & AGRICULTURE	IOT/SMART CONNECTED OBJECTS	MEDICAL / PHARMACEUTICAL / LIFE SCIENCE / HEALTH	NATURAL RESOURCES	PACKAGING / LOGISTICS	SAFETY / SECURITY	TRANSPORT / MOBILITY / AUTOMOTIVE	OTHER(S)	Total
ACTUATING	0	1	0	5	1	0	6	2	11	1	1	2	1	1	32
COMMUNICATING	3	4	5	14	5	5	7	14	24	2	10	6	8	5	112
COMPUTING / PROCESSING / DATA STORAGE	5	8	4	29	10	12	18	19	44	2	8	9	12	17	197
ENERGY HARVESTING / CONVERSION / STORAGE	0	3	0	1	7	0	2	1	6	0	3	0	1	1	25
SENSING	3	11	3	25	9	13	28	18	64	2	3	11	6	18	214
SIGNALLING (OPTICAL IMAGING, LIGHTING)	0	5	2	5	2	3	8	2	15	0	5	2	5	6	60
OTHER(S)	2	1	0	7	3	0	1	4	10	0	0	1	4	9	42
Total	13	33	14	86	37	33	70	60	174	7	30	31	37	57	

- the capability of the SAE initiative by IA/DIH project (or KDTs) to address end-user applications and product functionalities (**Fehler! Verweisquelle konnte nicht gefunden werden.**).



As the SAE programme has developed, the number of application experiments and sectors covered has increased. While this has led to a greater range of technologies and products and some cross sectorial usage of technologies, going forward it is recommended that in future initiatives (such as EDIHs) activities are pursued with a sectoral (more IA-like) or technology (more RIA-like) focus in order to concentrate efforts and enhance cohesion in specific areas. Where cross-sectorial synergies exist, there may be opportunities to bring together communities via joint awareness/innovation workshops to establish whether local limited joint projects are possible or whether widescale joint activities are needed which could be funded at a future stage. As there are many actors engaged in the community, underpinning this is a need to provide easy to engage with harmonised mechanisms that allow the stakeholders to work together in a win-win fashion.

Within the SAE domain there is a strong concentration on IoT and CPS solutions for different sectors underpinned by technology developments in specific areas. As Europe's priorities shift towards the Green Deal there is a need to encourage more focus on green developments as in the existing portfolio of applications "green" aspects are not specifically highlighted. Going forward, many applications are being driven by the New Data Economy which is pushing technology in terms of sensing, processing, data storage and communication. This is leading to a paradigm shift towards edge computing to deal with increasing processing and storage demands. In order to successfully exploit these technologies there is also a need to skill companies in security, privacy and safety for connected systems.

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2 Objective

The objective of task 2.1 was to further consolidate the SAE community originally created during the 2014-SAE phase 1 (CPSELabs, gateone, EuroCPS and SMARTER-SI) and already enriched by all IAs launched during the SAE-2017 phase 2 (SmartEES, Tetramax, FED4SAE and Diatomic), while capitalising upon the experience and knowledge achieved through the Smart4Europe CSA action.

An associated objective was to stimulate this consolidated SAE community by fostering and widening collaboration opportunities across IA areas towards, e.g. I4MS technologies to define at the typology of each IA/DIH community, highlighting the main categories of stakeholders (e.g. innovative technology suppliers, private investors, etc.), common categories as well as specificities across IA/DIH topics.

3 Methodology

A preparation work was done to establish common features across all DIH/IA projects launched in H2020 under Smart Anything Everywhere – SAE phase 3 (Figure 1) that would serve as a Common Reference towards collaboration and convergence in the future.

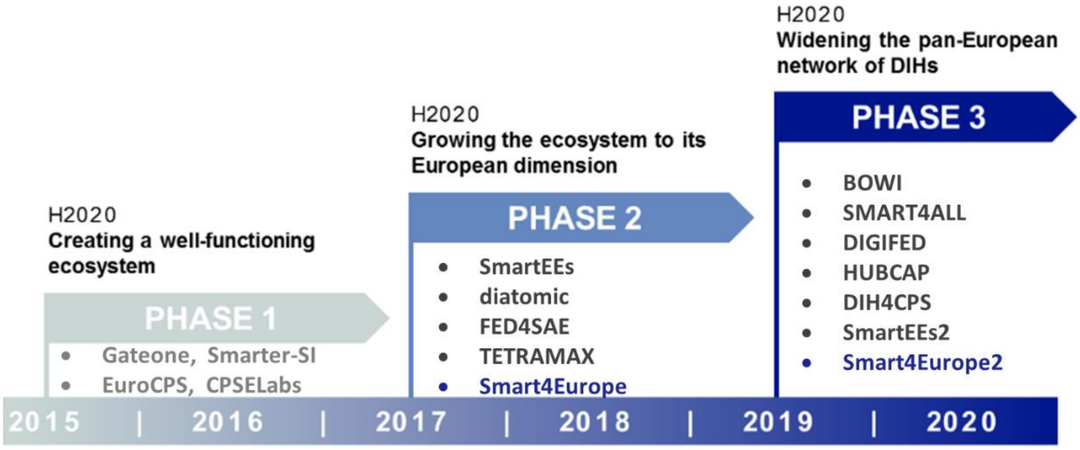

Figure 1: SAE evolution – Granted Innovation Actions

A format for this reference was prepared by CEA, which was discussed with and enriched by Hahn-Schickard and THHINK. It mainly consisted of the qualification of:

- DIHs network cohesion;
- Stakeholders;
- Key Digital Technologies (KDTs);
- Sectors of applications;
- Products functionality vs. KDT enables (according to a format[3] set by CEA and partners inside the 5E CSA project.

[3] https://5e-project.eu/wp-content/uploads/2020/04/Catalogue-of-WG-spots-of-the-3-electronic-areas-Revised-version-of-March-2020-with-39-opportunities.pdf

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Phase 1-3 IAs coordinators were subsequently contacted and invited to bring their inputs and priorities on these various topics. Among the 14 IAs, 12 entered in collaboration with S4E2 in the frame of the work carried out inside Task 2.1.

Data was collected through email exchanges, using Excel templates. Results were consolidated continuously, analysed and presented to IAs coordinators at WP2 collaboration workshops in order to maintain cohesion and give value back to individual IAs.

4 Results

4.1 SAE community cohesion

DIH coordinators were invited to assess their level of proximity with all DIHs. Although quite subjective, this assessment was used to evaluate potential cohesion gaps across DIHs and investigate them further in the frame of WP2.

Assessment was based on three levels of proximity (No: no proximity; L: low proximity; H: high proximity), to qualify the level of knowledge between DIH coordinator and/or project activity (Figure 2):

- DIH n knows well DIH m coordinator and/or project activity (High proximity) while DIH m knows little DIH n coordinator and/or project activity (Low proximity) → COHESION (Low/High proximity);
- DIH m knows little DIH p coordinator and/or project activity (Low proximity) while DIH p doesn't know DIH m coordinator and/or project activity (No proximity) → NO COHESION (No/Low proximity).

	DIH m
DIH n	H/L

	DIH p
DIH m	L/No

Figure 2: DIHs cohesion assessment (No: no proximity; L: low proximity; H: high proximity)

Cohesion assessment was done at the start of Phase 3 projects. Results are shown on Figure 3 and can be summarized as follows,

- Cohesion is observed amongst Phase 1 pioneering DIHs (projects closed), which were covering two topics & communities (SSI and CPS). Being the first movers, we can assume a high rate of identification with the newly built community and a high appreciation for the need of cooperation to be successful in community building;
- Cohesion is decreasing amongst Phase 2 DIHs (projects closed/closing) where additional topics & communities were added (CLEC for CPS/IoT and OLAE) and a kind of "settling into a ready-made nest" effect might have occurred;
- Cohesion amongst Phase 3 DIHs (projects ongoing) was still low at the time of data collection, as they were just starting at the time of assessment, and for which topics & communities remain more or less the same (FWE replacing OLAE) with one EU13 cross-topics DIH added. In the course of the lifetime of Smart4Europe2, collaboration was increased across IAs of the same technology areas (joint events, cross-dissemination, joint publication), complementarities exploited (broader portfolio for investors

events) and the geographical coverage enhanced (BOWI project / Ecosystem Building Event in Hungary).

Certainly, time is one main factor favouring cohesion, which can be observed as younger DIHs show lower cohesion among each other than previous ones. Partners need time and exchanges to come to know each other. Also, coordinators may not see a priority in cooperation with other IAs or the SAE community as a whole, which didn't happen as 12/14 IAs cooperated with S4E2 and 11 had Application Experiments data to share.

From a topic standpoint we observe,

- A reduction of cohesion within the same topic of CPS with time (when Phase 3 started), which might be due to the larger number of DIHs in Phase 3, new entrants and partners turn-over from previous Phases;
- No clear cohesion changes across topics, which remain anyhow relatively separate.

Finally, and focussing on ongoing Phase 3 DIH IAs, recommendations can be formulated on improving cohesion,

- Across CPS and CLEC for CPS topics related IAs;
- Between the cross-cutting BOWI IA and all other IAs.

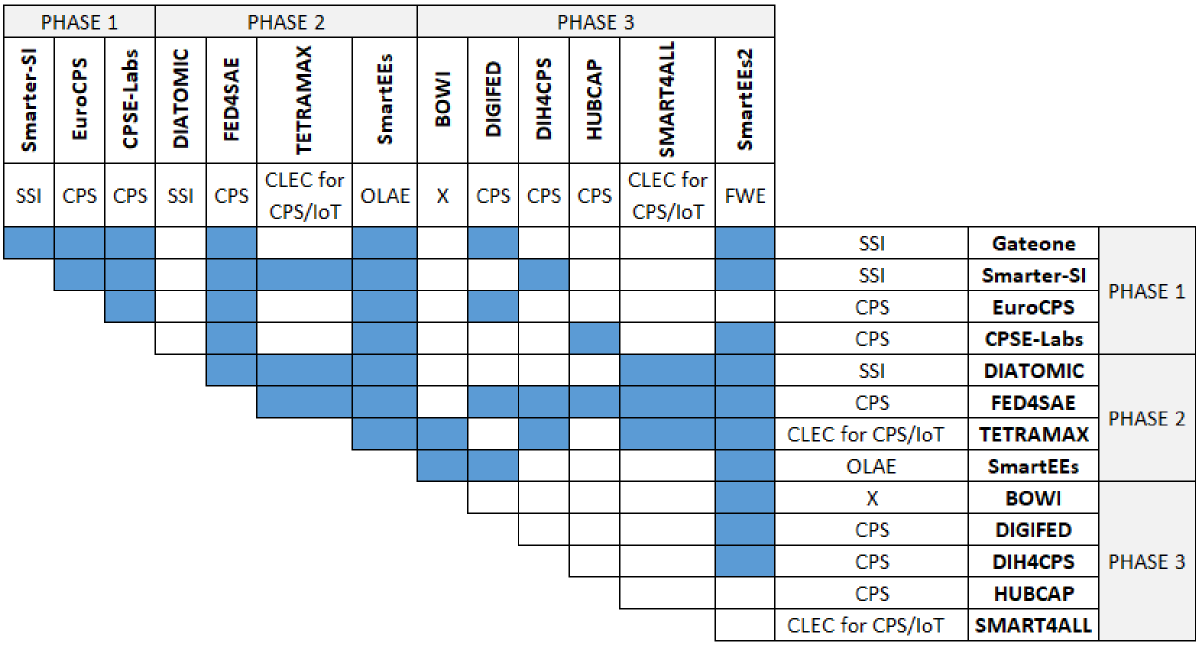

Figure 3: SAE community cohesion assessment (Cohesion = blue boxes)

Here strongest cohesion is likely to be obtained between actors working in the same or complimentary technology or application areas.

4.2 DIH Stakeholders

A classification of DIH stakeholders established inside SmartEEs-SmartEEs2 DIHs was proposed to all IAs in order to estimate the relative importance (High / Medium / Low) of each type of stakeholder for each IA: AUTHORITIES / RESEARCH / EDUCATION / INVESTORS / LARGE COMPANIES / SERVICES ORGANIZATION / SMES (incl. start-ups) & MIDCAPS.

		PHASE 1				PHASE 2				PHASE 3						
		Gateone	Smarter-SI	EuroCPS	CPSE-Labs	DIATOMIC	FED4SAE	TETRAMAX	SmartEEs	BOWI	DIGIFED	DIH4CPS	HUBCAP	SMART4ALL	SmartEEs2	High
AUTHORITIES	EC	H	H	H	H	H	H	H	H	H	H	L	L	No	H	11
	Reg/Nat	No	H	x	L	H	L	L	No	H	H	H	H	No	H	7
	Other	x	x	x	x	x	x	x	x	x			x	x	x	0
RESEARCH	RTO	H	H	H	H	H	H	H	H	H	H	H	H	H	H	14
	Universities	H	H	H	H	H	H	H	No	H	H	H	H	H	L	12
	Private labs	No	L	L	L	H	L	H	No	H	No	L	L	No	L	3
	Other	x	x	x	x	x	x	x	x	x		x	x	x	x	0
EDUCATION	Universities	No	H	x	H	L	H	H	No	No	L	L	H	H	No	6
	Academics of applied sciences	No	H	x	H	L	H	No	No	No	L	L	H	H	L	5
	Vocational training	No	L	x	L	L	H	No	No	No	L	L	L	H	H	3
	Private training	No	L	L	No	L	L	No	No	No	No	L	No	No	L	0
	Other	x	x	x	x	x	x	x	x	x		x	H	x	x	1
INVESTORS	Public	L	H	L	H	L	H	L	H	L	H	H	H	H	H	9
	Private	H	H	H	L	H	H	H	H	L	H	H	L	H	H	11
	Other	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0
LARGE COMPANIES	Tech provider	L	H	H	H	H	H	L	No	L	H	L	H	No	H	8
	Services provider	No	L	No	H	H	No	H	No	L	No	L	L	No	H	4
	Other	x	x	x	x	x	x	x	x	x			x		x	0
SERVICES ORGANIZATION	Incubators/Accelerators	No	H	No	L	H	L	L	No	No	L	L	L	H	L	3
	Clusters and industry associations	No	H	L	H	H	H	L	L	H	H	H	H	L	H	9
	DIH	No	H	L	H	H	H	H	L	H	H	H	H	H	H	11
	Other	x	x	x	x	x	x	x	x	x			x	x	x	0
SMES (incl. start-ups) & MIDCAPS	Tech provider	No	H	L	H	H	H	L	No	L	H	H	H	H	H	9
	Services provider	No	H	No	H	H	L	H	No	L	L	H	H	H	H	8
	Innovative company	H	H	H	H	H	H	H	H		H	H	H	L	H	12
	Other		x	x	x	x	x	x	x			x	x	x	x	

High relevancy
Low relevancy
No relevancy

Figure 4: DIH stakeholders vs. IAs

A first observation is that all categories of stakeholders (Figure 4) are relevant to all DIHs.

Then, ranking the relevance of these stakeholders across all IAs (Figure 5) allows to highlight the main features of DIHs:

- Technology and service providers & users (public or private) and funding parties (Institutional or private) appear to be logically at the core of the DIH ecosystem;
- Skills, training and education are inseparable of technologies to ensure innovation & business with a long term vision;
- Authorities have an important role to play to structure and support innovation at European level;
- Private funding is key, to take over public funding as technologies are getting close to their markets and, importantly, innovators must be connected to private funding as upstream as possible in their business development cycle.

RESEARCH	**RTO**
RESEARCH	**Universities**
SMES (incl. start-ups) & MIDCAPS	**Innovative company**
AUTHORITIES	**EC**
INVESTORS	**Private**
SERVICES ORGANIZATION	**DIH**
INVESTORS	**Public**
SERVICES ORGANIZATION	**Clusters and industry associations**
SMES (incl. start-ups) & MIDCAPS	**Tech provider**
LARGE COMPANIES	**Tech provider**
SMES (incl. start-ups) & MIDCAPS	**Services provider**
AUTHORITIES	Reg/Nat
EDUCATION	Universities
EDUCATION	Academics of applied sciences
LARGE COMPANIES	Services provider
RESEARCH	Private labs
EDUCATION	Vocational training
SERVICES ORGANIZATION	Incubators/Accelerators
EDUCATION	Other

Figure 5: Ranking of DIH stakeholders relevance.

This highlights clearly the need to provide easy to engage with, harmonised mechanisms that bring all the stakeholders together to provide win-win situations for all actors.

4.3 Key Digital Technologies

SAE has been supporting IAs under different *Areas*. These areas are covering several digital technologies, which have been mapped across IA projects (Figure 6).

As shown on Figure 7, *CPS* and *IoT* are the technologies SAE has been focussing on along with *advanced micro-electronics components* and *smart system integration*. *Customized low energy computing* coming as a complementary function to these.

Besides, *organic & large area electronics* and *flexible & wearable electronics* were added to the portfolio of key digital technologies, leveraging their singularity against conventional rigid inorganic semiconductor-based electronics.

	PHASE 1				PHASE 2				PHASE 3						
	Gateone	Smarter-SI	EuroCPS	CPSE-Labs	DIATOMIC	FED4SAE	TETRAMAX	SmartEEs	BOWI	DIGIFED	DIH4CPS	HUBCAP	SMART4ALL	SmartEEs2	
Cyber-physical and embedded systems	x		x	x		x	x		x	x	x	x	x		10
Customised low energy computing powering CPS						x	x		x	x	x		x		6
IoT	x		x	x	x	x	x		x	x	x		x		10
Organic and Large Area Electronics (OLAE)								x	x						2
Flexible and Wearable Electronics (FWE)									x					x	2
Advanced micro-electronics components	x	x	x		x	x			x				x		7
Smart System Integration	x	x	x		x	x				x	x				7
Other	x			Software and Systems Engineering					modelling and simulation, advanced high performance computing			Software and Systems engineering (model-based)	Ambient assisted living		5

Figure 6: Technologies vs. IAs

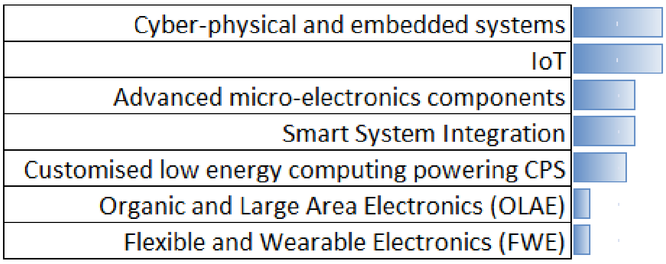

Figure 7: Ranking of technologies covered by SAE.

The areas of CPS and IoT highlight two key application domains and these are often reliant on the other technology areas identified in Figure 7 as constituent technologies, e.g. flexible and wearable technologies are a key driver in wearable IoT applications.

4.4 Sectors of Applications

IAs are more generally application-agnostic as they will serve third party requests to integrate and test the technologies they provide DIHs. The mapping was established giving the sector distribution of all the applications granted across all IAs (Figure 8).

The ranking of these sectors highlights with little surprise sectors of known importance in the European economy that are relevant and strategic to push through a digital transformation (Figure 9), such as Food & agriculture, IoT/Smart Connected objects, Transports/Mobility/Automotive, just to list the 3 top ones.

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	PHASE 1				PHASE 2				PHASE 3						
	Gateone	Smarter-SI	EuroCPS	CPSE-Labs	DIATOMIC	FED4SAE	TETRAMAX	SmartEEs	BOWI	DIGIFED	DIH4CPS	HUBCAP	SMART4ALL	SmartEEs2	High
(AERO)SPACE	L	L	L	L	x	L	No	L	Focus is on manufacturing SMEs and midcaps, not application driven	L	H	L	H	L	2
BUILDING / CONSTRUCTION	H	H	H	L	x	H	H	H		H	H	H	No	H	10
CONSUMER ELECTRONICS	H	L	H	No	x	H	H	H		H	L	No	L	H	7
DIGITAL MANUFACTURING	H	H	L	H	H	H	H	L		H	H	H	L	L	9
ENERGY	H	L	H	H	x	H	H	H		H	H	L	L	H	9
ENVIRONMENT	H	H	H	L	x	H	H	L		H	H	L	H	L	8
FOOD & AGRICULTURE	H	H	H	H	H	H	H	H		H	H	H	H	H	13
IOT/SMART CONNECTED OBJECTS	H	H	H	H	H	H	H	H		H	H	H	H	H	13
MEDICAL / PHARMACEUTICAL / LIFE SCIENCE / HEALTH	H	H	H	No	H	H	H	H		H	H	L	L	H	10
NATURAL RESOURCES	No	H	No	L	x	No	L	No		No	L	No	L	No	1
PACKAGING / LOGISTICS	H	H	No	No	x	No	No	H		No	H	No	No	H	5
SAFETY / SECURITY	H	H	L	H	x	L	H	L		H	H	H	L	L	7
TRANSPORT / MOBILITY / AUTOMOTIVE	H	H	H	H	x	H	H	H		H	H	H	H	H	12
OTHER(S)	?	x	x	Smart City/urban environments	x	x	x	x			x	x	x	x	

High relevancy
Low relevancy
No relevancy
No response

Figure 8: Application sectors vs. IAs

The application sectors vs. IAs mapping is certainly one element very much evolving with the open calls results. It can be expected to give a slightly different vision by the end of the SAE initiative, once open calls will be closed and Applications Experiments all selected.

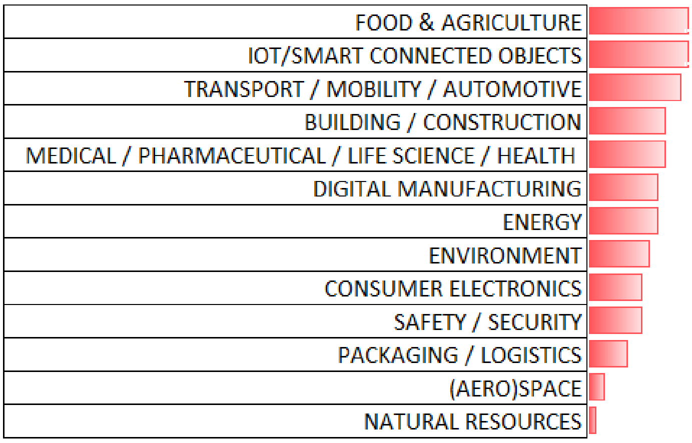

Figure 9: Applications sectors coverage by SAE.

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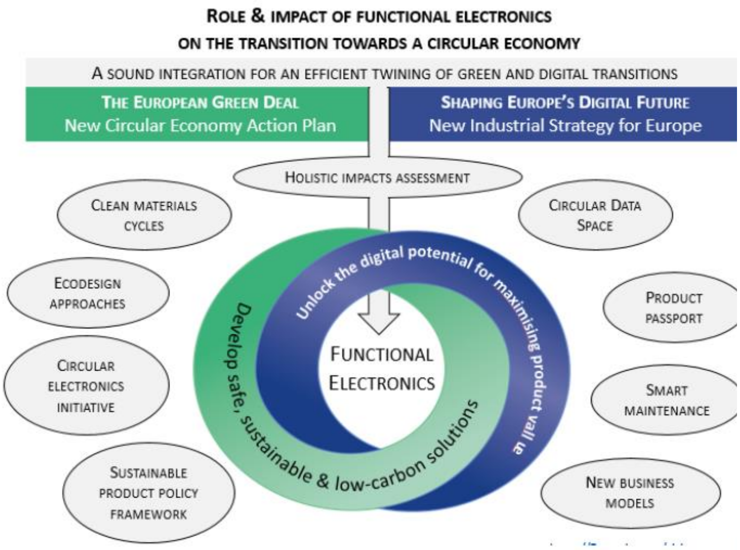
Notable in the coverage of the application sectors is the exploitation of IoT and CPS solutions. Aerospace is less well covered due to the specialist nature of this domain. SMEs and mid-caps in this domain are less likely to look for funding under the IAs due to the higher entry cost barriers. Notably an area underrepresented (or not explicitly represented) is green technologies. As Europe's priorities shift towards the Green Deal there is a need to encourage more focus on green developments in the future. This has been investigated by the 5E project through the production of a vision paper on *The role and impact of "Functional Electronics" on the transition towards a circular economy*[4], coordinated by CEA partner.

Figure 10: 5E vision paper on circular electronic[4].



4.5 Products functionality enabled by technologies

Following up a taxonomy exercise done in a sister-CSA project 5E[5] (deliverable D2.1), a mapping of product functionalities enabled by technologies across all IAs (Figure 11) shows that all singular functionalities of smart integrated system (defined in 5E) are relevant to all DIHs, with a high relevancy on SENSING; ACTUATING; COMMUNICATING; COMPUTING / PROCESSING / DATA STORAGE (Figure 12).

[4] https://5e-project.eu/wp-content/uploads/2020/10/Vision-Paper_Functional-electronics-for-a-circular-economy.pdf

[5] https://5e-project.eu/

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	PHASE 1				PHASE 2				PHASE 3						
	Gateone	Smarter-SI	EuroCPS	CPSE-Labs	DIATOMIC	FED4SAE	TETRAMAX	SmartEEs	BOWI	DIGIFED	DIH4CPS	HUBCAP	SMART4ALL	SmartEEs2	High
ACTUATING	H		H	H	H	H	L	H	BOWI is focused on widening DIHs active in SAE/I4MS, not technology push, development, etc.	H	H	No	H	H	
COMMUNICATING	H		H	H	H	H	L	H		H	H	H	L	H	
COMPUTING / PROCESSING / DATA STORAGE	H		H	H	H	H	H	L		H	H	H	H	L	
ENERGY HARVESTING / CONVERSION / STORAGE	H		L	L	H	L	H	H		L	L	No	No	H	
SENSING	H		H	H	H	H	H	H		H	H	H	H	H	
SIGNALLING (OPTICAL IMAGING, LIGHTING)	H		H	No	L	H	H	L		H	L	No	L	L	
OTHER(S)	x		x		x	x	x	x			x		x	x	

High relevancy
Low relevancy
No relevancy
No response

Figure 11: Product functionalities enabled by technologies

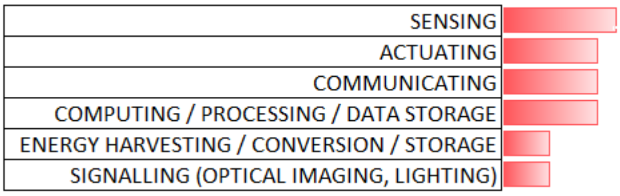

Figure 12: Product functionalities enabled by technologies

An additional mapping was performed crossing the information on the sectors of application and the information on the product functionalities at Application Experiments level (Figure 13). This map doesn't include the DIATOMIC and TETRAMAX data, which was not communicated. The total number of AEs under SAE is estimated to be around 400, so the current mapping has captured ~66% (265) of all AEs and will be updated until all running Phase 3 IAs' AEs are launched. The analysis allows to establish a SAE map which translates the overall capability of the SAE instrument to serve a given sector of application with a given product need. More interestingly, *hot spots* can be drawn giving areas of high demand where business replication could be envisioned and more structured actions. Also interesting is to observe the combination of functionalities need in a given sector of application or how a given functionality can serve different sectors.

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	(AERO)SPACE	BUILDING / CONSTRUCTION	CONSUMER ELECTRONICS	DIGITAL MANUFACTURING	ENERGY	ENVIRONMENT	FOOD & AGRICULTURE	IOT/SMART CONNECTED OBJECTS	MEDICAL / PHARMACEUTICAL / LIFE SCIENCE / HEALTH	NATURAL RESOURCES	PACKAGING / LOGISTICS	SAFETY / SECURITY	TRANSPORT / MOBILITY / AUTOMOTIVE	OTHER(S)	Total
ACTUATING	0	1	0	5	1	0	6	2	11	1	1	2	1	1	32
COMMUNICATING	3	4	5	14	5	5	7	14	24	2	10	6	8	5	112
COMPUTING / PROCESSING / DATA STORAGE	5	8	4	29	10	12	18	19	44	2	8	9	12	17	197
ENERGY HARVESTING / CONVERSION / STORAGE	0	3	0	1	7	0	2	1	6	0	3	0	1	1	25
SENSING	3	11	3	25	9	13	28	18	64	2	3	11	6	18	214
SIGNALLING (OPTICAL IMAGING, LIGHTING)	0	5	2	5	2	3	8	2	15	0	5	2	5	6	60
OTHER(S)	2	1	0	7	3	0	1	4	10	0	0	1	4	9	42
Total	13	33	14	86	37	33	70	60	174	7	30	31	37	57	

Figure 13: SAE Application Experiment map (265 AEs covered from 11/14 IAs: PHASE 1: Gateone; Smart-SI; EuroCPS / PHASE 2: DIATOMIC; FED4SAE; SmartEEs / PHASE 3: SMART4ALL; DIGIFED; DIH4CPS; SmartEEs2; BOWI)

It is interesting to compare this map with the same one established inside the 5E project that highlights the areas of collaboration at the interface of unconventional electronics, electronic smart systems and flexible & wearable electronics (Figure 14). This comparison (Figure 15) shows that sectors with similar high interest for digital technologies are medical & health, digital manufacturing, transport, IoT & smart connected objects, food & agriculture and building & construction. From a product functionality standpoint, sensing and computing / processing /data storage come up as the most important feature that digital technologies can enable. This is clearly where different digital technologies should play an important role in the future merging their intrinsic features to open new applications and business areas. In that sense, the SAE initiative has been one step forward in that direction highlighting individual but also joint capabilities of digital technologies, thanks to all individual IAs launched under SAE (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

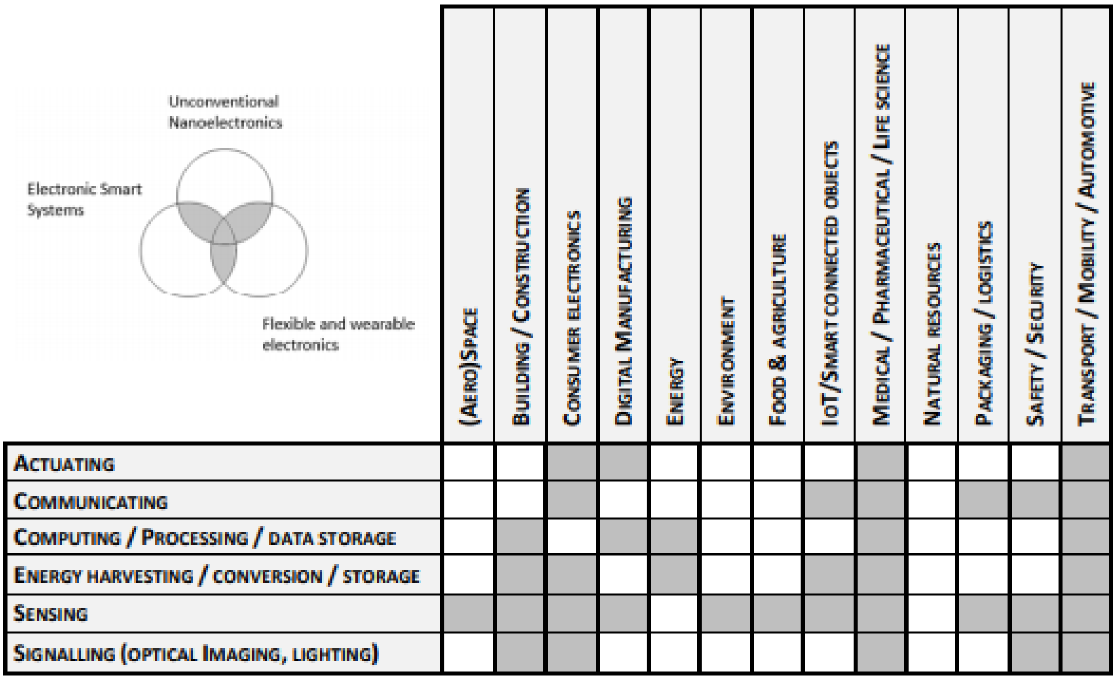


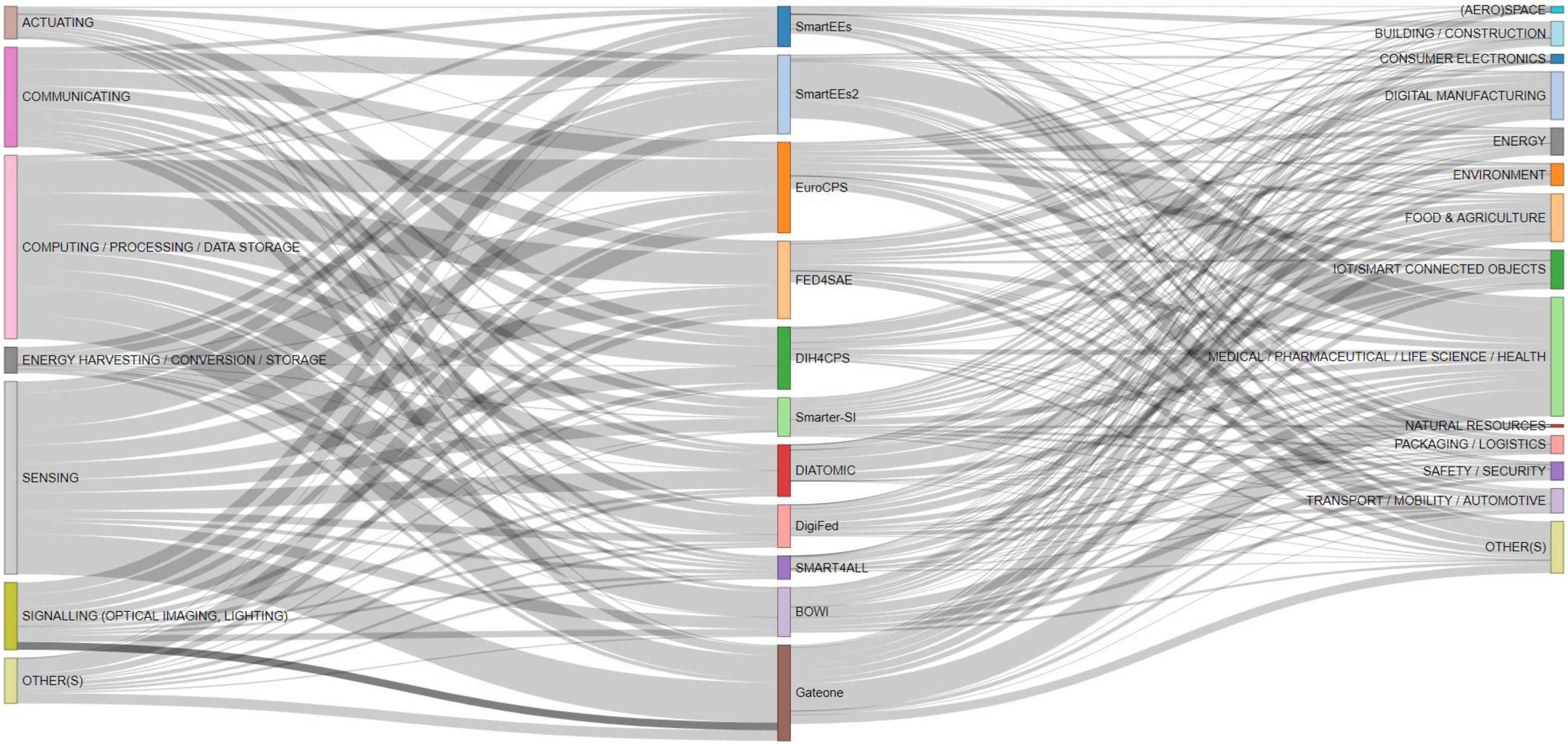
Figure 14: Areas of collaboration at the interface of unconventional electronics, electronic smart systems and flexible & wearable electronics[3] (5E project).

	(AERO)SPACE	BUILDING / CONSTRUCTION	CONSUMER ELECTRONICS	DIGITAL MANUFACTURING	ENERGY	ENVIRONMENT	FOOD & AGRICULTURE	IOT/SMART CONNECTED OBJECTS	MEDICAL / PHARMACEUTICAL / LIFE SCIENCE / HEALTH	NATURAL RESOURCES	PACKAGING / LOGISTICS	SAFETY / SECURITY	TRANSPORT / MOBILITY / AUTOMOTIVE
ACTUATING			0	5					11				1
COMMUNICATING			5					14	24		10	6	8
COMPUTING / PROCESSING / DATA STORAGE		8		29	10				44				12
ENERGY HARVESTING / CONVERSION / STORAGE		3	0		7			1	6				1
SENSING	3	11	3	25		13	28	18	64		3	11	6
SIGNALLING (OPTICAL IMAGING, LIGHTING)		5	2						15			2	5

Figure 15: S4E2 map filtered by 5E areas of opportunities.

Smart4Europe2 has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No. 872111.

Figure 16: the capability of the SAE initiative by IA/DIH projects (or KDTs) and complementarities.



Many applications are being driven by the New Data Economy in terms of a rapid increase in data gathering and processing. This is apparent in the linkage between sensing, processing, data storage and communication. This is a key driving factor for the future which is increasing the amount of processing that is being done at the edge. At the same time this is driving the need for improved security, privacy and safety in connected systems.

5 Conclusion

A fruitful exchange was set in place across 12/14 IAs, that enables first to establish the typology of DIHs launched under SAE in terms of,

- DIHs network cohesion;
- Stakeholders;
- Key Digital Technologies (KDTs);
- Sectors of applications;
- Products functionality.

This was the opportunity to promote cohesion, especially where no proximity existed across projects and coordinators at the start of Phase 3. The data collected showed similarities (stakeholders structure of DIHs) and complementarities (sectors of application targeted, digital enablers) of projects.

Application Experiments launched by IA projects, via open calls, have been analysed and compared to the vision set inside the sister CSA project 5E, which investigated the areas of collaboration at the interface of 1) unconventional electronics, 2) electronic smart systems and 3) flexible & wearable electronics digital technologies. This comparison has shown that sectors with similar high interest for digital technologies are,

- Medical & health;
- Digital manufacturing;
- Transport;
- IoT & smart connected objects;
- Food & agriculture;
- Buidling & construction.

From a product standpoint, two functionalities come up as the most important digital enablers,

- Sensing;
- Computing, processing and data storage.

These results suggest where different digital technologies should play an important role in the future, merging intrinsic features to open new applications and business areas. The SAE programme has been successfully supporting around 400 application experiments across many sectors as identified in this report. This diversity is a very positive factor in terms of providing wide coverage across the SAE field, however, it also presents challenges in terms of identifying opportunities for IAs to work together cohesively. Although the work has identified some cross sectorial usage of technologies, going forward it is recommended that in future initiatives such as the EDIHs that activities are pursued with a sectoral or technology focus in order to concentrate efforts and enhance cohesion in specific areas. Where cross-sectorial synergies exist there may be opportunities to bring together communities via joint awareness/innovation workshops. This should be explored in the first instance to identify if widescale joint activities are possible which could be funded at a future stage.

Many IoT and CPS solutions for different sectors have been identified and many of these are underpinned by technology developments in specific areas. Within the existing portfolio of applications “green” aspects are not specifically highlighted. As future programmes are now being driven by the Green Deal there is a need to encourage more focus on green developments. Going forward, many applications are being driven by the New Data Economy. This is pushing technology in terms of sensing, processing, data storage and communication leading to new concepts such as edge computing. In order to successfully exploit these technologies there is also a need to support development of new skills in security, privacy and safety for connected systems.