Identifying Innovation Pain-Points and Support Requirements amongst Privacy and Cyber Security Innovators

by Dr. Jamie Power

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Abstract

Rapid changes in technology infrastructure, the explosion of data, always-on-always-connected world, the emergence of "multiple internets" and escalating regulation and standards have and continue to offer fertile ground for innovation at product and service levels to increase ICT and personal security. Nonetheless, understanding of innovation management and practice remains fragmented, misunderstood and untamed by practitioners and researchers. Innovators operate within complex and turbulent environments, and are increasingly confronted with escalating and rapid technology developments, competitive global market competition and shorter product life cycles. While much information around innovation exists, the challenge of developing effective firm-level innovation practices, models and infrastructures underpins innovation endeavours. Based on the foregoing, this IPACSO Working Paper seeks to explore innovation lifecycle requirements at the firm-level through capturing the pain-points and self-reported support requirements of the stakeholders[1] participating in the IPACSO project overall.

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This White Paper is produced as part of the Innovation Framework for Privacy and Cyber Security Market Opportunities (IPACSO). It draws partially on the material in the Reports D3.1 and D3.2. It does not reflect the opinion of RIKON-WIT as institution or IPACSO as consortium, but the author's own.

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[1] The stakeholder data represents a crosscutting sample of innovators and researchers, it does not purport to be statistically representative of the entire PACS spectrum.

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I. INTRODUCTION

The EU Cyber Security Strategy coupled with Europe 2020 strategy and its flagship initiatives such as The Innovation Union and Digital Agenda all underscore the escalating importance of innovation. Reflective of this, opportunities for innovators in the privacy and cybersecurity domain is increasing. Innovation is widely recognized by industry, policymakers and academics alike as a sustainable and competitive enabler, nonetheless understanding of innovation management and practice remains fragmented, misunderstood and untamed by practitioners and researchers. Reflective of the above, innovation practice and requirements are far from straightforward. The challenges of transitioning technology related research developments and outputs to real-world deployment are well documented.

Innovators operate within complex and turbulent environments, and are increasingly confronted with escalating and rapid technology developments, competitive global market competition and shorter product life cycles meaning they must be reactive and flexible to organizational, technological and market shifts. Innovation therefore, does not occur within a vacuum and is impacted upon by a range of internal considerations and external contextual factors. While much information around innovation exists, the challenge of developing effective in-firm innovation practices, models and infrastructures underpins innovation endeavours.

Taking the above into consideration, a pressing challenge facing the cybersecurity and privacy community is transitioning technical R&D into commercial and marketplace ready products and services. Based on the foregoing, developing an understanding of PACS stakeholders' innovation challenges, and support requirements therein resents an integral and anchoring component of the IPACSO project overall, with reference to informing the development of appropriate and targeted support solutions. For this reason, and building on the outputs of IPACSO Deliverables D3.1 and D3.2, this working paper focuses on identifying stakeholders' innovation pain-points and support requirements.

A broad range of stakeholder categories from varying organisational sizes are represented in this working paper ranging from industry innovators in the PACS domain, research innovators, innovation intermediaries in the form of consultancy and industry support, in addition to funding and policy representatives (for an overview of demographics see Working Paper 1). The following is a summary of the key take-outs.

Key Take-Outs

Innovation challenges transcend infrastructural, market, knowledge, cost and legal domains
A significant finding is that all of the challenge factors (Legal, Market, Knowledge, Cost and Infrastructure) rated as both moderate and minor challenges for the respondents. Cost factors came first for all the respondents with a score in the region of 70%. One out of five respondents also identified knowledge and market factors as a serious problematic innovation challenge.

Innovation competency levels vary across the innovation value chain
High and competent levels of proficiency is the areas of ideation and concept development and design and business analysis were reported. Areas where respondents felt there was scope for improvement included the phases towards the end of the lifecycle including test, implementation and post launch.

Variance in innovation investment and performance
On average the greatest level of investment is directed in the early phases of the innovation lifecycle (ideation through to concept development); whereas less investment is directed towards the latter stages (test and implementation).

Broad scope for improvements:
Essential and high priority scope for improvement was recorded across the board (i.e. strategy, business intelligence, ideation, portfolio management, resource management development, and launch) by 25% -65 % of respondents. Strong requirements for innovation supports were reported in the areas of portfolio management, post launch, resource and competence management and business intelligence.

Innovation practice and requirements vary by the maturity levels of organisations.
The level of innovation practice and requirements of innovators varies depending on their respective maturity level. MNCs benefit from broad, complex and highly structured open innovation ecosystems, with defined, yet sometimes bureaucratic policies and strategies. Conversely, small scale start-up respondents report that their relative infancy in terms of maturity restricted their capacity to implement and deploy defined and structured innovation systems; largely due to financial, manpower and access to networking constraints.

PACS trends constantly move the goalposts
While market shifts and demands represent a key innovation component and driver in any industry setting, the constantly changing and hard to predict PACS environment exerts a significant challenge. The speed of innovation and short product cycles are signature aspects of digital markets which are continuously altered through emerging threat and vulnerabilities.

Importance of marrying business, technology and research excellence
There are varying levels of disconnect between research and technology development and innovation diffusion/implementation. While the imperative of underpinning innovation development activities with sound commercial business cases was recognised by all, competency and proficiency in this area varies significantly.

Bureaucratic funding/support mechanisms
Innovators who have current and previous experience of participating in both national and European innovation funding initiatives reported frustrations and concerns surrounding such instruments in light of the fast paced, short lifecycle demands of the PACS environment. It was recognised that with the advent of Horizon 2020, concentrated efforts were being mobilised to facilitate more agile innovation activities and a broader spectrum of funding KPIs with reference to innovation actions.

II. PACS INNOVATION CONTEXT

Within the PACS domain several challenges exist around bringing new innovations effectively to market (and are discussed in detail in IPACSO deliverables from WP2). Key solutions in the domain are of a technically complex nature, generally developed by highly technical individuals with significant experience in the industry. In addition, while the military and government space demands one-off bespoke solutions, the marketplace for PACS solutions serving general commercial requirements is highly saturated, with an ever growing array of PACS technology options. Such product saturation makes it difficult for PACS innovators to differentiate products from other offerings, to accurately evaluate their own product features versus those of competitors due to the vast competitive knowledge necessary, and ultimately for customers to find time to understand differences between products, especially when product benefits sound similar at the marketing level. This often leads to poor product decision making, and the cheapest alternative being purchased as opposed to the most effective one.

Other challenges relate to the reality that security is purchased as a risk mitigation measure rather than providing any direct return on investment value itself – making value justification arguments more difficult for PACS vendors to make, when the solution's value is related to some future security event whose timeline is unknown in advance. Furthermore, the difficulty of estimating tangible benefits leads to a problem of making a business case for spending on PACS. Often, companies only react with increased spending on IT security after a large-scale data breach has occurred. In such a situation, it is relatively easy for IT staff to make a business case. So timing is important for showing the value proposition of innovative PACS products and services. Moreover, as firms act under budget constraints, the option of spending more funds on improving IT security competes with other options that might improve revenues (such as spending more on marketing). If incentives are not aligned, they lead to suboptimal choices (see WP4 Deliverables for further information on economic incentives).

Effective security ultimately involves people, process and technology elements, so consultancy and service expertise is also necessary to sell security products effectively. This is reflected in some of the high-profile M&A activity in the space where key product vendors are acquiring outside service and consultancy expertise. Challenges of moving PACS innovations from prototype to adoption and integration in real world environments can also pose barriers and challenges.

Aside from strong internal capabilities in technology product management and innovation models and processes, PACS innovators with appropriate access to the best innovation ecosystems and environments are also at a key advantage. Key ingredients supporting such optimal environments include a strong cyber-academic base, access to a sustained skill and talent flow of scientists and engineers and appropriate funding and mentoring supports from venture capitalists. Flexible tech-transfer terms and appropriate logistics and ease of human interaction within innovation hub are also ideal ingredients.

III. INNOVATION CHALLENGES

As articulated in IPACSO Deliverable D3.1, the challenges and barriers to innovation are well documented: understanding of innovation management and practice remains fragmented, misunderstood and untamed by practitioners and researchers. Innovators operate within complex and turbulent environments, and are increasingly confronted with escalating and rapid technology development, global market competitive and shorter product life cycles requirements (Garud, et al., 2006); innovation is impacted upon by a range of external contextual factors in tandem to internal considerations, including but not limited to, strategy and culture, resources and skills, leadership, organizational structure and external linkages (Rothwell, 1994); (Cormican & O'Sullivan, 2004). Innovation practice and requirements are far from straightforward "…*most innovation is messy, involving false starts, recycling between stages, dead ends and jumps out of sequence*" (Tidd, 2006). Indeed, varying attempts have been made to articulate conceptual order on the innovation processes of organisations, in the form of innovation process models. The variety amongst the models is the consequence of a lack of consensus as to how an innovation process should look like, given the unique requirements, contexts, environments, and purposes for which they are developed (Tidd, 2006); (Eleveens, 2010).

Taking the above into consideration, a pressing challenge facing the cybersecurity and privacy community is transitioning technical R&D into commercial and marketplace ready products and services. "New and innovative technologies will only make a difference if they are deployed and used. It does not matter how visionary a technology is unless it meets the needs and requirements of customers/users and it is available as a product

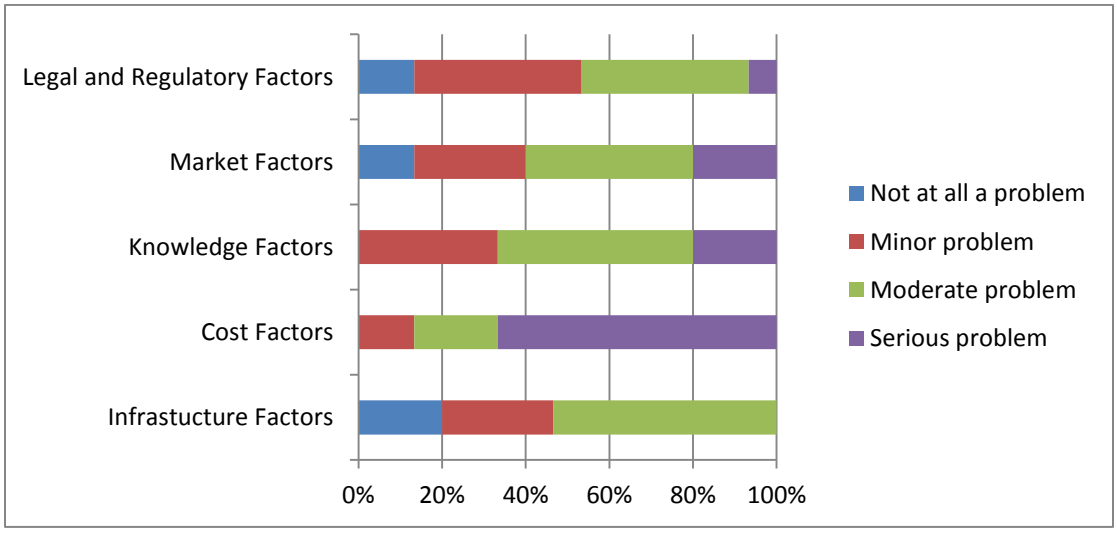
via channels that are acceptable to the customers/users" (Maughan, et al., 2013).

To explore such what challenge factors are relevant, the IPACSO respondents were asked to rate how the following typical innovation challenges related to their organisation. The typical innovation challenges included:

- Infrastructure Factors (e.g. lack of innovation governance, inadequate innovation management procedures, ad-hoc R&D practices, lack of collaborative structures etc.);
- Cost Factors (e.g. lack of appropriate funds within the enterprise/ from external sources, innovation costs too high etc.);
- Knowledge Factors (e.g. lack of qualified personnel, limited information on markets, difficulty in finding cooperation partners etc.);
- Market Factors (e.g. market dominated by established enterprises, uncertain demand for goods and services etc.);
- Legal and Regulatory Factors (e.g. escalating legislative and regulatory requirements).

As presented in Figure 1, variance was reported across all categories of challenge factors. Unsurprisingly, cost factors came first for all the respondents with a score in the region of 70%. One out of five respondents also identified knowledge and market factors as a serious problematic innovation challenge. A significant finding is that all of the challenge factors rated as both moderate and minor challenges for the respondents.

Figure 1 Innovation Challenges



Elaborating upon these findings,

Table 1 synopsizes a range of related and additional challenges which impede undertaking innovation in the PACS context. Replicating the findings above, cost, regulatory, infrastructure and market forces are represented, in addition to business knowledge, threats, awareness and acceptance challenges.

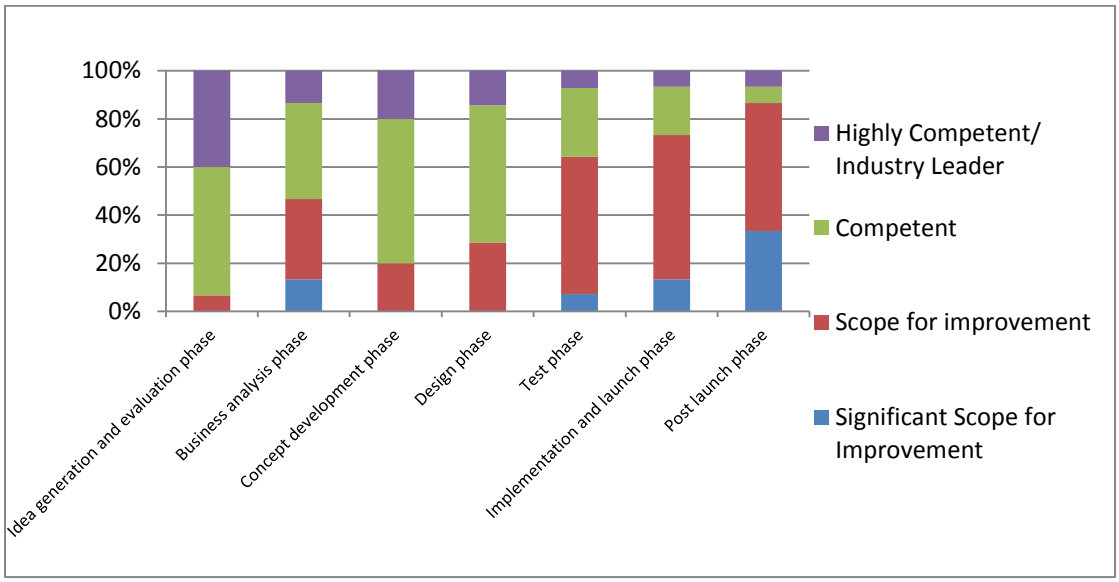
Table 1 Innovation Barriers in PACS

Human (skills, intelligence, availability)	• Very high expertise of internal resources • Access to the right developers with specialised competence/ Skilled resources • Idea implementers • Staff shortages
Funding/ resources	• Financial resources/ funding (we operate 100% on cash flow) • Cost of development • Competing internal resources
Policies/ procedures	• Internal practices • Common policies missing • IPR and patent landscaping
Market issues	• Competitiveness between collaborators • Market positioning issues
Regulation	• Regulatory barriers • Navigating the minefield • Stumbling block • Detect, block and clean new malware
Threats	• Detect, block and clean new malware
Business Knowledge	• Business modelling, • Underpinning business case • Diffusion and route to market
Awareness and Acceptance	• Acceptance of new technology concepts • Education in privacy enhancing technologies
Top management	• Corporate engagement and involvement

An extensive corpus of literature has accumulated documenting the range of end to end phases relating to innovation processes (Rothwell, 1994); (Cormican & O'Sullivan, 2004); (Tidd, et al., 2005); (Dooley & O'Sullivan, 2001) which typically consist of: idea generation, selection, development, implementation and launch, and post launch in some cases (as synthesized by (Eleveens, 2010). A common thread emerging from the literature is that while there is logical order in these phases, the order is not necessarily linear. Typically, models start with some form of idea generation or searching stage. Secondly, a selection phase follows to determine which projects are feasible

and potentially lucrative enough to be pursued. All models start with some form of idea generation/ searching and selection stage, followed by a development phase where the idea is developed into a tangible product, process or service and culminates in implementation/launch typically entails marketing, distribution, logistics and customer facing activities. When asked to rate their level of competency across the various phases of an innovation lifecycle (illustrated in Figure 2), the respondents identified high and competent levels of proficiency is the areas of ideation and concept development and design and business analysis. Areas where respondents felt there was scope for improvement included the phases towards the end of the lifecycle including test, implementation and post launch.

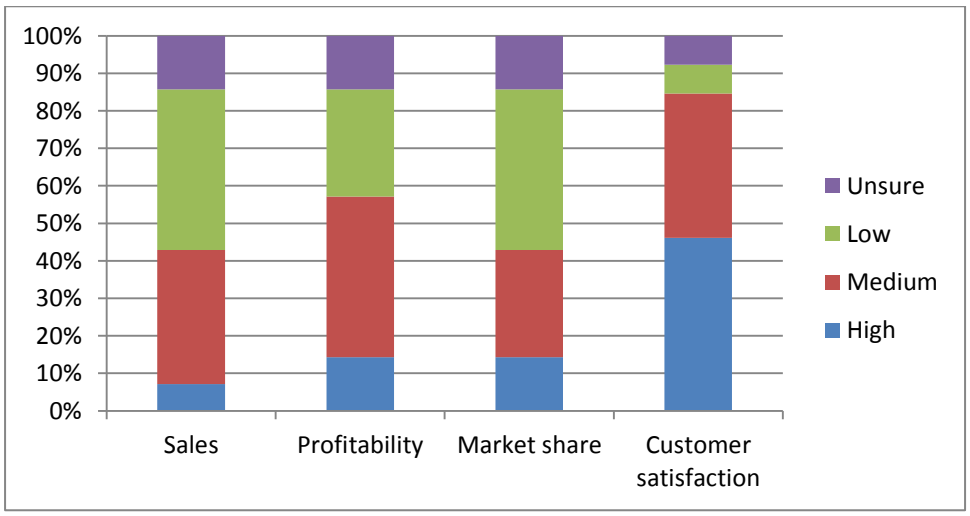
Figure 2 Innovation Competencies across Lifecycle Phases



Cognisant that innovation performance does not occur within a vacuum, the literature base identifies a range of organisational, environmental and contextual factors which impact on the processes deployed (Rothwell, 1994); (Van de Ven, et al., 1989); (Cormican & O'Sullivan, 2004); (Tidd, et al., 2005). The AT Kearney House of Innovation model, which underscores the European Commission's IMP³rove programme maps such innovation lifecycle and organisational/contextual factors (for an overview of these components see IPACSO Working Paper 1).

In terms of performance/output from innovation, the results collated were largely anecdotal. IPACSO respondents identified how many innovation projects were conducted during the last three years and how many of these outcomes have been launched. The mean of the number of projects was 9 and on average only one reached the launch stage. A range of additional metrics were presented to the respondents to ascertain their performance levels from their existing commercialised innovations (launched within the last three years) and Figure 3 indicates the self-reported sales, profitability, market share and customer satisfaction levels. While it must be noted that responses returned are of an anecdotal nature, all respondents reported low-to-unsure levels of sales, profitability and market share which may be symptomatic of the fragmented and highly diverse nature of the PACS domain.

Figure 3 Innovation Performance Metrics



IV. Scope for Innovation Supports

As previously documented in the introduction and in detail in IPACSO deliverables D3.1 and D3.2, the challenges and barriers to innovation are complex and varied. When questioned about innovation areas/aspects where they consider support, guidance and knowledge would be of benefit

the responding IPACSO stakeholders highlighted a range of requirements and scope for opportunities. The following categories were presented to the respondents and they were asked to rate which, if any were a priority for them:

- Innovation strategy implementation (e.g. Innovation vision, goals, roadmaps and integration with corporate strategy
- Business intelligence (e.g. Tools and techniques for identifying, extracting and analyzing business data, customer needs, emerging technologies, competitor moves, revenue by products, etc.
- Idea management (e.g. process followed to generate ideas for new products/services, usage of external/internal sources)
- Product/service portfolio management (e.g. prioritizing creation, enhancement or termination of an offering, process or product feature)
- Technology portfolio management (e.g. prioritizing research and technology investments)
- Development & launch (e.g. all steps required to transform the original idea to a launched product/service/process)
- Post-launch – Product upgrading and continuous improvement
- Resource & competence management (e.g. managing your internal and external capabilities, training, development activities and network building)
- Innovation metrics (e.g. metrics and KPI's to assess the success of innovation performance and implementation).

Figure 4 presents the results, and indicates essential and high priorities across the board in all of the areas with between 25% -65 % of respondents. Strong requirements for innovation supports were reported in the areas of portfolio management, post launch, resource and competence management and business intelligence. Elaborating upon these findings, Table 2 synopsizes a range of related and additional innovation requirement areas, in terms of areas presenting scope for improvement. Replicating the findings in above, cost, market, human and business intelligence are strongly priority in addition to calls for networking, collaboration and innovation/risk awareness building.

Figure 4 Scope for Innovation Supports

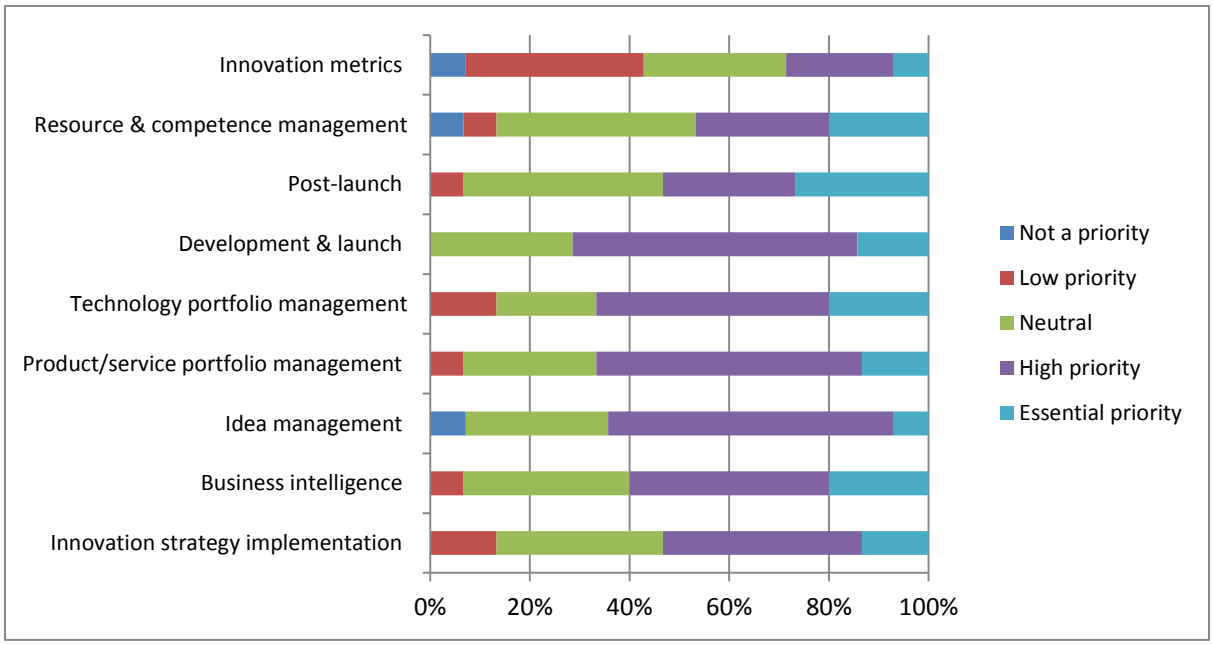


Table 2 Additional Scope for Innovation Supports

Economic Supports	• Funding of expensive projects • EU/Government incentives in innovation investment (Tax incentives) • Economic assistance and investment supports
Networking and Collaboration supports	• Assistance in linking with major companies • Programmes to encourage smaller and larger companies to collaborate
Market Supports	• Regulation screening and patent searching • Targeted initiatives aimed at channel development • Assistance in scanning the market • Resources for market knowledgebase identification, needs identification
Human/People supports	• Top management commitment • Access to key competence for hiring • Dedicated training and consultancy supports
Business Development Supports	• Market positioning • Marketing • Business intelligence • PR • Implementation and customer engagement • Benchmarking
Risk and Awareness Building Supports	• Initiatives for encouraging disruptive innovation engagement • Confidence building in ideation and follow through • Initiatives to promote European enterprises to be leaders as opposed to followers

V. CONCLUDING OBSERVATIONS

Our initial findings which triangulates survey, interview and desk research indicates a diverse and varied perspective of innovation organisation and practice (see Working Paper 1 for further details) and hence, challenges in the PACS domain:

- Multiple and integrated innovation models are utilised which draw upon elements of technology push, demand pull, cooperative, networking and open innovation principles. This variance creates difference scenarios of requirements both in terms of the stakeholders involved and the phases/gates deployed.
- The level of innovation practice and requirements of innovators varies depending on their respective maturity level.
- While market shifts and demands represent a key innovation component and driver in any industry setting, the constantly changing and hard to predict PACS environment exerts a significant challenge.
- At a high level, the research indicates that existing competencies and investment are directed in the early phases of the innovation lifecycle (ideation through to concept development); whereas significant scope and requirements occur in the latter stages (test and implementation).
- A significant finding is that innovation challenges transcend infrastructural, market, knowledge, cost and legal domains. Cost factors came first for all the respondents with knowledge and market factors also representing a serious problematic innovation challenge.
- The stakeholders identified a broad scope for innovation supports across the entire innovation value chain and ecosystem (i.e. strategy, business intelligence, ideation, portfolio management, resource management development, and launch).
- A common denominator from the interview findings is the varying levels of disconnect between research and technology development and innovation diffusion/implementation. While the imperative of underpinning innovation development activities with sound commercial business cases was recognised by all, competency and proficiency in this area varies significantly.

Table 3 synthesises the key findings gleaned from the exploration of PACS innovation challenges and requirements within the sample of innovators who engaged with the IPACSO project.

Table 3 Synthesis and Key Take-Outs

No "one size fits all" perspective	• Too many variables • Different scenarios of practice and focus → varied requirements
Innovation ecosystem	• Stronger integration between the different functions (internal) /contexts (external) • More than the technical product/service output: infrastructural, ecosystem, and 'soft' people related initiatives
Innovation lifecycle requirements	• End to end • Stronger competencies in early phases; stronger requirements in latter stages • Maturity level exerts influence
Networked and Open Innovation	• Fragmented market and supply chains → opportunities for network/open innovation approaches • Supports/measures for encouraging , incentivising and facilitating collaboration/ networking are required
Competency issues	• Disconnect between technology and business development • Skill shortages on both technology and commercial sides. • Supports across the entire innovation value chain: • i.e. innovation action instruments (feasibility/business case) through to commercialization programmes. • Engaging with end-users • Networking and collaboration facilitation • Networking/collaboration and engaging with end-users (testing/validation etc.)
Challenges and requirements	• Transcend infrastructural, market, knowledge, cost and legal domains. • Balance of hard and soft supports/intervention; instruments, tools, consultancy. • RDI funding/project programmes better aligned to realities of PACS market (dynamism, timescales, bureaucracy etc.). • Maturity level – avenues for consideration (1) Start up (2) Scale up, etc.

Given the diversity reported, it is clear that innovation challenges and requirements are far from straightforward and there is no one-size-fits-all solution or panacea.

VI. Addressing Innovation Pain-points via the IPACSO Framework

In Table 4 below, potential innovation challenges have been mapped against the modules of the IPACSO Framework to indicate scenarios where support is made available within. See http:///www.ipacso.eu to navigate the online framework and access the suite of 96 innovation support tools across the key five module topics.

Table 4 Addressing Innovation Pain-Points with the IPACSO Framework

Guiding Principle	Pain Point	IPACSO Modules
Processes for generating ideas	Identifying avenues, methods and capabilities for generating and screening ideas	IDEAS
Screening and evaluating ideas		
Prioritising ideas	Understanding where to prioritise and focus efforts around innovation	
Assessing market landscape at macro and micro levels	conducting and validating market research, and integrating this with product/solution development	MARKET
Understanding policy and legal landscape relevant to PACS	Difficulty combining aspects of PACs innovation with product elements in a commercially viable and efficient manner	
Understanding economic factors influencing the PACS and wider ICT domain	Difficulty in knowing how to access finance, both for R&D and NPD activities	
Developing a value proposition and business case to drive the innovation	Understanding the steps, procedures, activities involved in bringing new PACs product/service innovations to market – difficulty in getting PACs solution to market successfully	
Adapting/developing an underpinning business model		
Developing a product management and development philosophy within the organisation	Understanding the steps, procedures, activities involved in bringing new PACs product/service innovations to market – difficulty in getting PACs solution to market successfully	PRODUCT
Procedures for mapping product/service market and technology vision into the future		
Understanding how product and service features interact within proposed offering		
Adopting/adapting an innovation model and philosophy for your organisation	Difficulty around building better innovation process, infrastructure and environment in the	

Guiding Principle	Pain Point	IPACSO Modules
	organisation	PROCESS
Measuring, monitoring and managing innovation capabilities, performance and maturity	Difficulty around building better innovation/process in the organisation	
Procedures for channeling R&D investment and output into commercialisable actions	Bridging the "valley of death" between R&D and commercialisation	
Training employees across all aspects of the innovation lifecycle	Understanding how to empower, attract, develop and motivate individuals and groups in organisations including defining roles and responsibilities for innovation activities	PEOPLE
Acquiring and sustaining people talent		
Incentivising innovation engagement		

The IPACSO Innovation Framework is holistic in its approach, depending on your interest you can choose any of the five categories or gates. Depending on your interest and prior work, you can browse the five categories and discover the different components underneath. Browsing through the whole model and following the suggestions for the templates you will be guided through an innovation process.

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