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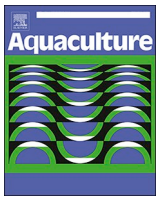

Implementing aquaculture technology and innovation platforms in Asia

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1. Introduction

Aquaculture has emerged as one of the fastest growing agri-food systems, playing an increasingly important role in global nutrition security and contributing economic welfare to rural and coastal regions (Beveridge et al., 2013; Béné et al., 2016). At the same time the sector in globally important regions of the world like Southeast Asia remains vulnerable to a range of production risks, related to farming conditions, disease, processing and trade issues related to environmental and social sustainability (Little et al., 2016, 2018; Ahmed and Thompson, 2019; Bush et al., 2019). For the aquaculture sector to maintain its important role as a globally important sector, continual innovation of farming systems and sector level systems of response to key issues like disease are therefore required (Lebel et al., 2010; Asche and Smith, 2018; Joffre et al., 2018).

Innovation in and of the aquaculture sector is considered necessary to resolve existing production risks and also transform the sector towards sustainable intensification (Edwards, 2015; Joffre et al., 2017, 2018). This includes, but is not limited to, ongoing domestication of species, improved seed production, species selection and selective breeding, improved biosecurity and health control and the development of new feed ingredients to replace fish meal and fish oil (Naylor et al., 2000; Bostock et al., 2010; Bunting, 2013; Sorgeloos, 2013; Little et al., 2018). To have any hope of achieving sustainable forms of intensification, an integrated approach is also required that responds to, as well as anticipates, changes in the ecological, social and institutional conditions of production (Lebel et al., 2010; Joffre et al., 2017; Little et al., 2018; Belton et al., 2020). To balance both responsive and anticipatory innovation processes, system level approaches to innovation are needed that can integrate a wide range of actors representing the complex between technological, institutional, social and environmental aspects of the sector.

Multi-stakeholder technology and innovation platforms have been used in a range of sectors, including aquaculture, as a means of fostering learning process among different actors to enhance the capacity for responding and anticipating change at a system or sector level (see Schut et al., 2016; Pigford et al., 2018). In the EU, establishing and connecting technology platforms has become the central approach to stimulate innovation for sustainable aquaculture, as shown by the establishment of the European Aquaculture Technology and Innovation Platform (EATIP, see for e.g. Bostock et al., 2016). Likewise, in its ambition to secure sufficient future imports of sustainably farmed fish from Asia, the EU is also extending its efforts to promote innovation through platform development in Asia with the aim of creating links that can foster the involvement of European firms and universities in the region.

Running from 2017 to 2019 the European Commission funded European-Asian Technology and Innovation Platform (EURASTIP) international support action (Promoting Multi-stakeholder Contributions to International Cooperation on Sustainable Solutions for Aquaculture Development in South-East Asia) aimed to establish and develop self-sustaining national multi stakeholder platforms to promote sustainable intensification of aquaculture in Asia (EURASTiP, 2016). Three national pilot platforms (NPPs) were established in Bangladesh, Vietnam and Thailand, with the longer-term goal of preparing and evaluating the potential for developing an EU equivalent 'Asian Technology Innovation Platform' and an eventual bi-lateral 'European-Asian Technology and Innovation Platform'. Reflecting the extension of a European model of technology platforms, EATIP was taken as a starting point by the project as a model for establishing these platforms, with recognition that the process of practical adjustment to different national contexts within Asia would be necessary.

The three national pilot platforms established through the EURASTIP project provided a natural experiment for understanding the complexities of not only establishing multi-stakeholder technology and innovation platforms, but also transferring a European understanding

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into an Asian context. The development of technology and innovation platforms is already understood as an inherently complex process involving the cooperation of people from different institutional and cultural contexts (Woolthuis et al., 2005; Regeer et al., 2009). It is also understood that innovation processes through technology and innovation platforms are largely unpredictable because of the diverging interests of stakeholders, the wider political and economic conditions under which collaboration is being fostered, and the complexity of the technical issues involved (see Kilelu et al., 2013). However, as Joffre et al. (2017) argue, it remains less clear how the form and function of a technology and innovation platform emerges in response to the institutional setting within which it is embedded. It is also unclear whether the structure and purpose of these platforms can or should be predetermined, as is implied by transferring a European aquaculture innovation platform model to Asia, or whether their structure will inevitably reflect the institutional and cultural conditions within which they emerge.

In this paper we report on the results of a guided reflection on the establishment of the three multi-stakeholder national aquaculture technology and innovation platforms in Bangladesh, Vietnam and Thailand. Those involved in setting up these national platforms (all authors of this report) were led through a stepwise reflection on how they received, understood and *translated* the goals of technology platforms from Europe to Asia. This translation process, defined as an intentional transfer of assumptions and design of technology and innovation platforms from one cultural and socio-political context to another, is central to our analysis (e.g. Mosse and Lewis, 2006; Smith, 2007). Our results demonstrate two key insights into the translation and development of technology and innovation platforms in diverse national contexts. First, we show that the development and translation process of technology and innovation platforms internationally is non-linear and pluriform, rather than linear and 'planned'. Second, we find that through the process of translation a series of frictions and design challenges emerge. Together these insights demonstrate the importance of international translation processes involving multi-stakeholder technology and innovation platforms and their role in wider processes of food systems innovation.

The paper is structured as follows. We first provide further background on technology and innovation platforms and their role in food systems innovation. We then outline the methodology used to reflect and synthesize the experiences of those (co-authors) involved in setting up the national platforms before presenting the main results. In the final two sections we further reflect on these experiences to identify key frictions and design challenges that we argue can guide the design of aquaculture technology and innovation platforms in the future.

2. Technology innovation systems and platforms

Innovation systems provide a lens to understand the development and role of the national pilot platforms developed through EURASTIP as multi-stakeholder technology and innovation platform.

An innovation system is defined as "a network of organisations, enterprises and individuals focused on bringing new products, new processes, and new forms of organisation into economic use, together with the institutions and policies that affect the way different agents interact, share, access, exchange and use knowledge" (Hall et al., 2006, vi-vii). The innovation systems approach has developed particularly in the fields of agriculture and forestry, with a strong but not exclusive focus on African small-holders (Rametsteiner and Weiss, 2006; Stone et al., 2011; Klerkx et al., 2012). It has more recently also been applied (albeit sparingly) to understanding innovation processes in aquaculture (Joffre et al., 2017). Research on innovation systems focuses on the learning process that results from the interaction between different actors and components of a system, such as different types of farmers, researchers, facilitators and policy-makers, which (ideally) enhances the capacity of the system to respond to changes.

Technology and innovation platforms are defined as long-term relational spaces for orienting interaction between multiple actors for stimulating changes that "have greater effects in the broader environments in which these actors operate" (see also Klerkx et al., 2010; Kilelu et al., 2013, p. 66). These platforms can play a central role in system level innovation and problem solving, especially where social and technical restructuring of production systems, policies, and value chains is required (van Mierlo and Totin, 2014; Schut et al., 2016). As outlined by Kilelu et al. (2013), they do this in different ways. They can facilitate and identify innovation challenges and opportunities, advocate for institutional change, broker new networks, incubate new organizational forms, coordinate learning and/or disseminate knowledge and/or technology.

As variously argued, technology and innovation platforms rarely emerge spontaneously nor autonomously. They instead require a degree of intermediation to create "complex multi-actor configurations" in a given sector and coordinate the ongoing interaction between these actors (Klerkx and Leeuwis, 2008, 2009; Devaux et al., 2009). But as also noted, the performance and impact of technology and innovation platforms also depends on the ongoing ability of the actors involved to reflect and reflexively adapt the form and function of the platform in response to their changing needs and in response to the wider economic, social and political context within which they operate (Klerkx and Leeuwis, 2009; Schut et al., 2016; Totin et al., 2018). This mix of interests and context in turn lead to differences in the form and function of these platforms; in terms of them being more or less hierarchical (closed) or networked (open) (e.g. Felin and Zenger, 2014), more or less inclusive and/or representative of a full spectrum of actors in a sector (e.g. van Paassen et al., 2013), more or less driven by private sector or government (e.g Oh et al., 2016).

In our analysis of the three national pilot platforms we explore how the form and function of the innovation platforms, as well as the issues and outcome they produced, differed between the countries in which they emerged. Our analysis is focused in particular on the dynamic translation of technology and innovation platforms from one cultural and socio-political context to another (e.g. Mosse and Lewis, 2006; Smith, 2007). Such dynamism, we argue, means that the intended meaning of concepts, like 'multi-stakeholder', 'innovation' and 'platform', can be lost or transformed as they travel to different locations and reflexively adjust to meet existing expectations and practices.

For the purposes of our analysis we focus on three related steps in this process of translation.

First, we identify the assumptions that underpinned the goals and methodology of the national pilot platforms developed by EURASTIP. These assumptions include many of the functional goals set out at the start of the project such as: (1) contributing to common standard setting and legislation, (2) facilitating the creation of business opportunities for industrial partnerships between Europe and Southeast Asia, (3) reducing risk to animal and human health, (4) increasing EU consumer's confidence in seafood products from Asia, (5) contributing to reinforce the EU-ASEAN Partnership and (6) the underlying EU-ASEAN high level policy dialogue on science, technology and innovation. However, they also include underlying assumptions of the function of innovation platforms, such as trust and transparency, representative membership, democratic decision making and legitimacy and authority.

Second, we explore how these assumptions were interpreted by the intermediaries in setting up the national pilot platforms in Bangladesh, Vietnam and Thailand. Here we focus on how the intermediaries understand the assumptions, goals and principles of technology and innovation platforms. For instance, how do the intermediaries understand the design of the NPPs and methodology introduced from EATIP to implement them in different national contexts within Asia? And, from their understanding, what did the end point of the project look like in terms of a functioning technology and innovation platform? We assume that during this process of interpretation the intermediaries interacted with and responded to the interests of the members involved in the

platform (Bisseleua et al., 2018), as well as inserted their own cultural and social understanding of what innovation and platforms mean (Schut et al., 2016).

Third, we identify how these interpretations were put into practice. Here we assume that the assumptions and expectations of the intermediaries and members were translated into activities, membership requirements, levels of participation and discussions that affected the form and function of the multi-stakeholder platforms. By focusing on these practices we are also able to identify the extent to which the activities and outcomes were 'planned' and 'emergent'. For example, planned outcomes included the identification of issues through strategic research and innovation plans, policy outcomes like Best Management Practices (BMPs), as well as conferences, trainings and websites. Emergent outcomes refer to problem identification outside Strategic Research & Innovation Agenda and the development and implementation of (joint) solutions (in terms of research, policy and practice).

These three steps of translation allow us to explore how apparent 'distortions' in the design of technology and innovation platforms from the European context are potentially productive transformations in and of themselves. By observing variation in the form and function of these platforms we identify specific 'translation practices' that are produced by intermediaries and members in response to a number of generative design challenges addressed in the process of establishing and running these platforms. These design challenges, as such, can be considered as logical outcomes as the translation process in which the goals and outcomes of these platforms are inevitably reshaped to fit different contexts.

3. Methodology

The experiences of how the three national pilot platforms were developed and the different kinds of outcomes that have emerged in the process were reflected on in a two-day workshop in October 2019. The workshop was set up as a guided reflection organized by researchers from Wageningen University, University of Stirling, Ghent University, the ASEAN Fisheries Education Network, and with the NPP facilitators from Bangladesh, Vietnam and Thailand. Given the co-produced nature of this guided reflection all but one of the participants from the workshop (who withdrew for personal reasons) are co-authors on this paper.

Following the three analytical steps of translation outlined above, the goal of the workshop was to understand how the NPP design was received, understood and subsequently translated into different (Asian) contexts. It was made clear from the start that the workshop was not an evaluation of the participants' performance in the project. Instead, the workshop focused on what had happened and why in the process of setting up the NPPs and what the intended or unintended outcomes of that process were. In doing so, the participants collectively reflected the different challenges that were faced over the duration of the EURASTIP project.

A reflexive approach involves a collaborative form of evaluation that takes in different understandings and prioritizations of those involved in the development of the NPPs (van Mierlo et al., 2010; Arkesteijn et al., 2015). It also means being open to both positive and negative outcomes that have emerged in the process which may not fit prior expectations of success and impact. Attention to unforeseen challenges helps to learn from experience to improve future technology and innovation platform approaches (Arkesteijn et al., 2015). In summary, instead of using a blueprint to assess performance, a reflexive approach aims to find out what happened, what challenges were faced, and what kind of (planned and unplanned) outcomes can be identified, in order to revise – if needed – the blueprint.

By actively guiding the intermediaries involved in the project through a reflexive evaluation of the project a deeper reflection was possible on how the very problem definition, objectives and trajectories as defined at the start of the project had possibly changed. Iteration and reflection on such fundamental changes allows for revision of the policies, methodologies and design of technology and innovation platforms to make the approach better fit and more feasible in future applications (see van Mierlo et al., 2010).

The guided reflexive evaluation was completed by dividing representatives of members of the EURASTIP consortium into four groups: three groups consisted of coordinators/facilitators of the three national pilot platforms, while the fourth group consisted of the research team from Stirling University who had coordinated the development of these platforms over the lifespan of the project.

Each group presented one slide at the start of three consecutive sessions corresponding to the three steps of translation, followed by break-out groups designed to compare their experiences in each step. Each of these sessions ended with plenary discussion of the results of the break-out groups, during which emphasis was put on identifying differences and similarities. In the final round the participants collectively synthesized the experiences collected over the first day and half into a set of generative design challenges.

4. Description of the national pilot platforms

In this section we summarise the development of the three technology innovation platforms as derived from the reflexive evaluation workshop. Following the analytical steps introduced in section two, the platforms are described in terms of: (1) how the participants have understood and perceived the goals of the national pilot platforms, (2) how they interpreted these NPPs in the three different countries into practice, (3) what kind of planned and emergent changes and outcomes came from this process in the different countries (see Table 1 for a summary).

4.1. Bangladesh technology and innovation platform (BATIP)

The development of the Bangladesh Technology and Innovation Platform (BATIP) was coordinated by WorldFish – a research organization part of the Consultative Group International Agricultural Research (CGIAR). From the perspective of the NPP coordinator based at WorldFish, the goal of BATIP was two-fold. First, BATIP was understood as a platform designed to establish and implement a Strategic Research and Innovation Agenda (SRIA), matching the structure of the EATIP, with the express goal of providing longer term support to the Bangladesh aquaculture industry. Second, BATIP was understood as providing a platform for solving the immediate problems faced by highly diverse actors with different and often competing interests.

The coordinator and BATIP members alike saw a number of opportunities for a new multi-stakeholder technology and innovation platform in Bangladesh – many of which align with the wider expectations of innovation platforms. There was general agreement between the members that by linking farmer and industry associations and government into one platform BATIP could enable faster response times from research to practice than previously was the case. It was also expected that by including both farmers and industry BATIP could foster greater ownership of both the issues the industry faces, as well as the responsibility for problem solving. Additionally, BATIP was seen as an opportunity to develop new business opportunities based on technology and greater cooperation between national, regional and international levels through the development of private sector networks. While following the model created by EATIP, in terms of establishing a SRIA and representative membership, central to its establishment was the expectation that the platform should be self-initiating, mutually beneficial and lead to shared objectives.

In practice, BATIP successfully brought together a wide range of public and private actors. As expected, the platform was able to engage universities, government (e.g. the Department of Fisheries and the Bangladesh Fisheries Research Institute), key NGOs (e.g. BRAC) and industry associations. Membership of BATIP was semi-formalized, meaning that participation was maintained based on active engagement

Table 1
Summary analysis of three national technology innovation platforms.

	BATIP	VINATIP	ThaiTIP
Understanding and perception of goals	• Long term support to the aquaculture industry for problem solving • Support timely translation of innovations from research to practice • Foster greater ownership of issues and problem-solving • Develop new business opportunities	• Create connections between multi-stakeholder as a basis for collaboration with EATIP • Contribute to the central government's goals for shared problem identification and innovation with industry	• Create national platform to identify and solve common issues with private sector • Engage European (research) stakeholders where deemed relevant
Implementation in practice	• Broad semi-formalized membership based on personal networks of facilitator and representative structure of existing associations • Iterative development of SRIA and organization of multi-stakeholder events based on but not following EURASTIP steps • Strong producer engagement • Incorporated diverse set of actors across multiple regions • Innovation projects developed domestically and facilitated through international collaboration	• Highly planned participation based on the facilitators' networks • Rapid and centralised development of SRIA • Followed all the expected steps outlined by EURASTIP • General lack of producer engagement • Incorporated diverse actors through centralised planning and representative structure • Innovation projects linked to brokering debates on European trade (Food safety, BMPs etc.)	• Initially conformed to structure proposed by EATIP with membership derived from the networks of facilitator, and Director General of Fisheries • Iterative approach to SRIA development was unsuccessful • Membership extended membership of the steering committee to include NGOs and academia and a new management team with connections to DoF and private sector • Identification of Multiple problem based and stakeholder led innovation projects
Planned and emergent outcomes	• BATIP limited because it was seen as a means of enabling the government's role in research and extension • Inclusion of various national associations with different interests and the large variation in species, regions and culture intensity led to clear differences in priorities • Decentralized structure allowed for more attention to regional and species-specific issues • National platform provided opportunity to coordinate multiple species and regional producer and processor associations	• VINATIP enabled centrally steered but trusting relations between farmers and business actors • Key driver for inclusion was opportunity for brokerage meetings that enabled connections and debate on trade related issued with Europe • Centralised structure meant participation limited to export trading companies rather than small-scale farmers • Policy-focus and highly planned nature led to policy development rather than technical innovation	• ThaiTIP resulted in networked flexible structure that brought together actors around current, urgent problems • Inclusion of actors was problematic when problem orientation was not clear and when suspicion persisted of European input to platform • Networked structure gave clear private sector role that was additional to existing extension services of the Thai DoF • Range of technical innovations emerged from problem oriented multi-stakeholder (domestic and international) collaborations facilitated by platform

rather than by by-laws and membership fees. Similarly, the identification of members emerged through a combination of existing networks, especially those of the WorldFish-based coordinator, and a gradual realisation that representative bodies already existing in the country needed to be included. As a result, membership was based on reputation and the degree they represented the aquaculture industry as a whole rather than based purely on stakeholder mapping. Furthermore, the shift to a representative model builds on a long history of industry associations (see FAO, 2019). Examples include the Carp Hatchery Association, the Tilapia Hatchery Association, the Shrimp Farmers Association, the Bangladesh Aquaculture Product Companies Association (BAPCA), Bangladesh Frozen Foods Exporters Association (BFFEA), and the Shrimp Hatchery Association of Bangladesh (SHAB). Each of these associations represents a large membership and lobby the government for extension services and representation in national legislation.

The intention of establishing a national level technology innovation platform was seen at first as a means of enabling engagement between industry associations with government and research actors. The initial goal of BATIP was to provide a national level means of identifying common problems related to production, foster international connections to the private sector and university researchers, as well as linking to policy and legislation related to trade. The national platform also organized multi-stakeholder events, as an outcome of the SRIA, around four thematic areas: (1) production, (2) education and research, (3) policy and regulations, (4) value addition, trade and marketing. The national BATIP was also able to engage with policy makers on the National Fish Health Management strategy.

Linking these actors at the national scale, however, became problematic for three main reasons. First, BATIP was perceived as a means of enabling the government's role in extension and research. Second, the inclusion of national-level associations opened up a series of challenges in both overcoming specific interests of associations representing different species and as such vastly different issues related to production and trade. For instance, between differences in terms of species, life stage, industry segment, and value on domestic and international markets. Third, the variation between species, regions and culture intensity led to clear differences in priority in different areas. For example, the differences between shrimp, carp and pangasius in relation to the risk of disease, profitability, vulnerability to food safety rules in export markets and different levels of technology employed.

The challenges BATIP faced with convening a diverse set of actors at the national level led to the formation of a decentralized representative structure with nodes in Jashore, Khulna, Satkhira and Cox's Bazar. This structure emerged in response to the needs of its membership, including the difficulty of attending meetings and communicating across poorly connected regions. BATIP linked these associations at the sub-national level, and in doing so built on the regional success of the industry where clusters of producers together with pre- and post-harvest actors have emerged as productive commercial ecosystems (e.g. Hernandez et al., 2018; Hu et al., 2019). These regional platforms enabled the identification of problems relevant to specific regions and sectors that do not receive attention at the national level. For example, the regional

platforms facilitated international networks, notably to Thailand, to transfer and adapt airlift technology to improve productivity and profitability of tilapia polyculture.

While the decentralized structure of the innovation platform enabled more precise problem identification, it also required a substantial amount of resources. For BATIP to continue it will require a formal registration as a foundation in order to seek further funding. Finally, while the decentralized structure of BATIP has the potential to foment a sense of ownership among members, the personal nature of the national coordinator's networks remains centrally important to its future success.

4.2. Vietnam technology and innovation platform (VINATIP)

The Vietnam Technology and Innovation Platform (VINATIP) was intermediated by academics at the Faculty of Fisheries at Nong Lam University (NLU) in Ho Chi Minh City. NLU has a long history of research and education in the South of Vietnam, and also has an extensive network of alumni now working in different functions in the Vietnamese aquaculture sector.

NLU had two goals for VINATIP. First, related most directly to the goals of EURASTIP, NLU aimed to create multi-stakeholder connections that would provide a basis for collaboration with EATIP on common key issues related to aquaculture development between Vietnam and the EU. Second, VINATIP would contribute to the central government's goals and vision for sustainable aquaculture development by creating relations between government, private sector, research institutes and NGOs to foster shared problem identification and innovation.

Despite there being a number of initiatives aimed at multi-stakeholder interaction in the Vietnamese aquaculture sector, the coordinator argued that VINATIP provided a number of new opportunities. Central to these opportunities, is the role of NLU as a 'neutral' broker. Other platforms in Vietnam are either focused primarily on representation of producers through both political and commercial 'societies' and 'associations' (e.g. VINAFIS, VINAPA), or on trade and marketing issues (e.g. VASEP) (for details see Anh et al., 2011; Ha et al., 2013). Additionally, the perceived neutrality of NLU, as an 'insider' actor of the Vietnamese aquaculture sector, enabled them to foster trusting relations between both farmers and business actors. The coordinator also emphasized that this neutrality enabled it to generate interest from their existing partners in the aquaculture industry to attend, for instance, brokerage meetings with European companies over the course of the project.

The structure and membership of VINATIP remained close to that of EATIP – formed around involvement of public and private actors in working groups, who together developed a SRIA. The establishment and implementation of VINATIP followed the expected steps of stakeholder analysis, setting up steering committees and four thematic working groups. This was followed by a visioning workshop with more than 30 participants and an SRIA workshop with more than 100 participants. In addition, VINATIP was active in coordinating two brokerage meetings between Vietnam and Europe – the first in Brussels (2018) and the second in Ho Chi Minh City (2019).

The highly planned nature of VINATIP, however, presents two of the challenges and consequences for how multi-stakeholder interaction is understood and enacted compared to EATIP.

The first challenge is the active participation of the private sector for engaging in problem solving and innovation for improved sectoral outcomes (e.g. efficiency, reduced risk, added value etc.). Membership of VINATIP was planned and driven by existing relations, including alumni networks of NLU, which extended to a range of aquaculture-related companies. This was partly pragmatic given the challenge of generating interest in the platform. However, it was also in response to the difficulties of generating and maintaining private sector involvement in innovation processes. Research and development remain highly competitive between Vietnamese companies – including production related issues affecting product quality that are commonly thought to be pre-competitive (e.g. water quality and disease). This appears to disincentivize participation in open platforms like VINATIP. Participation in VINATIP was instead limited to international companies. Given the role of Vietnamese processors in organizing small holders access to the market, VINATIP also had limited success in accessing small-scale farmers – or engaging those who did participate in discussions on innovation and limited access to financial capital.

The second challenge, in part related to the lack of producer involvement in VINATIP, was the overall orientation towards planned vs. reactive (or problem oriented) innovation. The structured approach taken by VINATIP matched the steps and organization of EATIP. It also matched the expectations around planned participation held by the Vietnamese government, in terms of aligning with the organized representation of the industry, executive branches of national and provincial government and academia. However, this also appeared to limit the innovation process to policy – through for instance, the close alignment of the SRIA with the government priorities and activities to promote the 'sustainable growth' of the sector; neither of which were stakeholder or working group led. This policy focus also appears to have compounded by the EU funding behind VINATIP, with both government and industry interested in resolving trade issues related to changing food safety requirements (e.g. the emergent Registered Exporter (REX) program currently being implemented by the EU) and the wider consumer trust of Vietnamese seafood products (see for e.g. Little et al., 2012; Murk et al., 2018). The overall tendency of VINATIP to focus on planned or programmed issues appears to have influenced a strong alignment of the SRIA with the development of Best Management Practice (BMPs).

The structured nature of VINATIP enabled engagement between private sector actors and the government, relying on the extensive network of the large NLU team and its alumni. Compared to Thailand and Bangladesh, where coordination was based mainly around an individual, VINATIP was more collectivist calling on the time and talents of a small group of current and retired faculty members at Nong Lam. This may have facilitated the comparatively rapid and comprehensive stakeholder mapping and early organization of meetings but perhaps delayed decision making with stakeholders in some areas. However, the future of the platform remains unclear. To be successful moving forward VINATIP needs greater authority than can be provided by an independent facilitator like NLU. While contradictory to the notion of an autonomous and stakeholder driven platform, it appears that VINATIP – in the context of a centralised Vietnamese state – is likely to be more successful if it has closer connections to the central government. However, while this policy engagement can afford greater authority, the legitimacy of VINATIP among the industry (and especially farmers) requires a higher degree of demonstrated outcomes or impact if it is to successfully move forward. In doing so VINATIP may enable system level innovation by bridging both policy and technology extension.

4.3. Thai technology and innovation platform (ThaiTIP)

The Thai Technology and Innovation Platform (ThaiTIP) was intermediated by INVE – a Belgian research-based aquaculture nutrition and health technology company with over 20 years of experience working in Thailand. With INVE as an intermediary ThaiTIP came closest of the three platforms established under EURASTIP to the goal of private sector-led innovation. INVE understood the goals of ThaiTIP as providing a national platform to identify and solve common issues in Thai aquaculture by engaging private sector actors. They also recognised a role for European (research) stakeholders when deemed relevant to furthering the ambition of ThaiTIP by its members.

The development of ThaiTIP can be broken into two distinct phases. In the first year ThaiTIP was established in line with the structure of EATIP with membership derived largely from the networks of INVE. These actors included companies from the export sector, processing,

hatcheries, as well as farmer associations and the government, broken up into two working groups – one on shrimp and one on seabass. During this initial phase the ThaiTIP steering committee had representatives from various stakeholders, but was chaired by the Deputy Director General of the Department of Fisheries. While enabling a close alignment to the goals of the government, the perceived dominance of government representatives had two effects on the form and function of the platform.

First, there was suspicion that ThaiTIP was serving European rather than Thai needs and objectives. ThaiTIP was established at the time the EU issued a 'yellow card' under the Illegal, Unregulated and Unreported (IUU) regulation for human rights abuses and forced labour issues in the Thai seafood sector (see Marschke and Vandergeest, 2016; Bush et al., 2017). This came after the EU suspended Thailand's status under the Generalised Scheme of Preferences in 2015 and subsequent suspension of discussions for a EU-Thailand free trade agreement as an EU response to slow reforms to military rule, starting in 2014. While not related to the EURASTIP project, or technology innovation in general, the yellow card meant that seafood was temporarily suspended from export to the EU. The Thai industry and government alike also felt excluded by not being involved in the formulation of the EURASTIP project – building on a longer history of frustration with the outcomes of development aid (for a detailed history see Muscat, 2016). Additionally, the ongoing Seafood Taskforce, an industry initiated multi-stakeholder platform established in response to concerns over unfree labour in the seafood sector, attracted considerable time and resources of the sector (see Marschke and Vandergeest, 2016). Combined, these ongoing issues limited the development of the SRIA by the platform. By not having this SRIA as a guide specifically for aquaculture, ThaiTIP was seen as an additional and unwanted level of oversight on the sector. As a consequence, the goals of ThaiTIP were deemed to be 'unclear' and the platform did not receive strong support by the members of the nucleus committee.

Second, from the perspective of the government stakeholders, it was not clear what function the platform could play beyond the role of the Thai Department of Fisheries (DoF). The DoF plays a central role in technology development and extension in Thailand. It also has a close relationship with the private sector and perceives itself as brokering much of the R&D between different stakeholders. This is despite there being a number of private sector initiatives that have played a central and ongoing role in technology development both with and without input from the DoF. For instance, there is a long history and considerable success around innovation within large Thai companies, such as Charoen Pokphand and Thai Union (for detail see Goss et al., 2000; Lebel et al., 2016), as well as in provincial level shrimp associations (Kassam et al., 2011), including many smaller private enterprises through their membership of such associations. As a result, the additional contribution of ThaiTIP within this network remained ambiguous to the members of the steering committee. The slow progress of the stakeholder mapping that would have allowed better understanding of the role of other stakeholders and their importance in forming the working groups may have contributed to this.

To overcome the ambiguity and lack of support for ThaiTIP a new approach was taken from the second year of the project onwards. Among these changes were an extended membership of the steering committee to include NGOs, academia and a new management team with a combination of senior and younger staff with direct connections with the DoF and the private sector. This led to the implementation of the Shrimp Health Resources Improvement Project (SHRImp Project) and also the association of a seabass project led by the National Science and Technology Development Agency (NSTDA) with ThaiTIP.

The SHRImp Project was an ongoing initiative managed by the Sustainable Fisheries Partnership (SFP) that was unable to successfully identify and enroll partners in their work due to the sensitivity of working on disease related issues. ThaiTIP enabled the SHRImp Project to link their existing international partners (IDH, Walmart Foundation and SFP) by facilitating an MoU with the Department of Fisheries. Subsequently, ThaiTIP was able to facilitate engagement with farmers in Southern Thailand and broker relations with other technical experts who provided direct input into advancing diagnostic methods – including FAO and XpertSea, Stirling University and INVE Thailand.

ThaiTIP supported the seabass project by enhancing an existing multi-stakeholder platform initiated by the Thai Marine Fish Farmers Association with Thai Union, NSTDA and academia to solve some of the challenges faced in seabass culture. While understanding and mapping the different stakeholders and projects going on in Thailand, and having NSTDA as part of the ThaiTIP nucleus committee, ThaiTIP facilitated connections with international buyers in European markets. At the same time, ThaiTIP was able to facilitate data collection and disease risk modelling at the farm level by linking to international academic researchers (University of Stirling). Like the SHRImp project, this support enhanced the existing capacity of this project by building evidence that in turn increased buy-in from otherwise distant stakeholders.

These changes collectively triggered a series of new projects, including (1) a soft-shell crab platform and (2) the Larvi Workshop (postponed for external reasons). A common feature of all of these initiatives was a stakeholder driven problem linking industry, government, NGOs and scientists in search of an applied solution.

The second phase of ThaiTIP did not follow the structured representative innovation platform model. Instead, it appears that the success experienced by ThaiTIP came from the ability of the facilitator to bring different actors together around current, urgent problems. ThaiTIP as such adopted a networked form, based on a set of relationships oriented to solving problems that are temporary and also flexible in terms of inclusion and exclusion of actors deemed relevant to solving the issues at hand.

While a networked structure has enabled ThaiTIP to instigate a problem/solution oriented approach to technology innovation, it also presents a number of challenges into the future. To remain nimble, ThaiTIP (like VINATIP and BATIP) requires ongoing funding. However, unlike VINATIP and BATIP, securing such funding appears to be even more difficult without an ambition for a representative structure. It is also unlikely that a private company can successfully lead ThaiTIP given the potential for conflicts of interest to arise and exclusion of other private sector actors (whether intentionally or not). More appropriate hosts for ThaiTIP may instead be in independent government bodies with experience in multi-stakeholder technology innovation such as NSTDA.

5. Discussion: Understanding platform diversity

The three platforms in Bangladesh, Vietnam and Thailand are similar in that they were able to bring together multiple public and private actors to engage in an attempt to collectively address key problems in the aquaculture industry. The three platforms also all instigated systemic processes of social and technical innovation in the aquaculture industry to address complex production related issues such as disease, water quality, and feed. In some instances, they also engaged with trade related issues – both in terms of raising issues related to trade disputes, as in the case of Thailand, and attempting to redefine standards as seen in Vietnam. However, returning to Joffre et al. (2017), the platforms also show considerable divergence in their form and function that reflects the institutional settings within which they were introduced.

The differentiation of the three platforms demonstrates the process of translating the design of already diverse national level multi-stakeholder technology innovation platforms from one set of contexts, in this case European countries, to three different cultural and socio-political contexts. We observe that the meaning of some key concepts central to technology innovation platforms were not changed or reinterpreted. However, we also see that the meaning and functionality of how the very concept of a 'multi-stakeholder platform' does differ between

Structure	Networked	Convening	Hierarchical
Nature	Transient	Persistent	Fixed
Function	Problem Solving	Deliberative	Policy Oriented

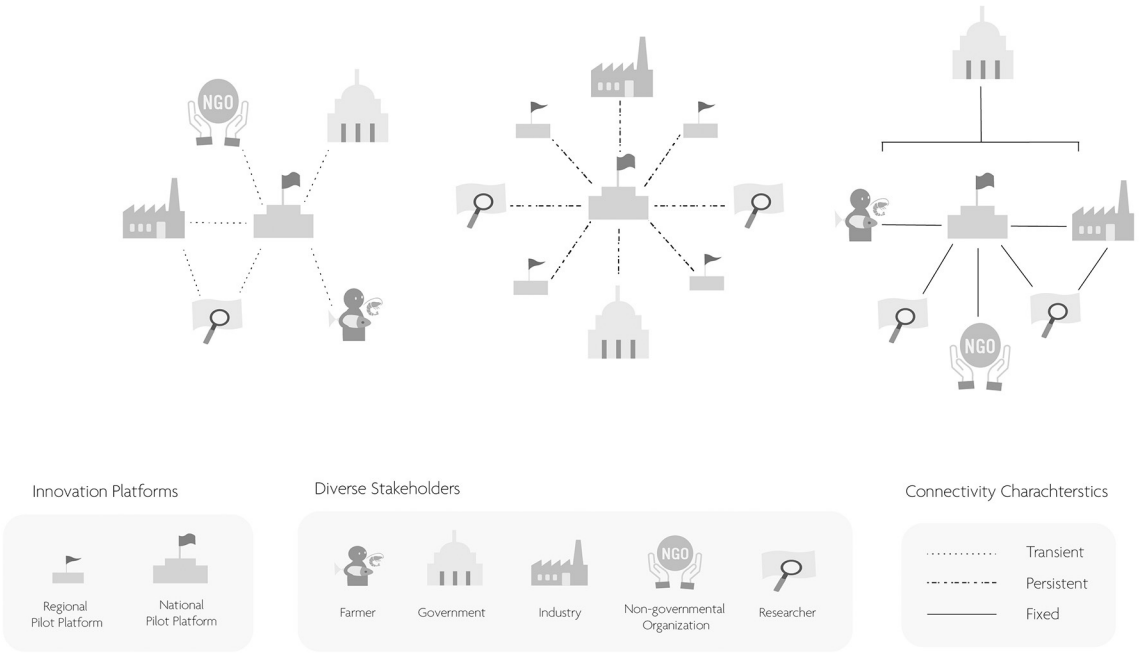

Fig. 1. Emergent types of multi-stakeholder technology and innovation platforms.

Bangladesh, Vietnam and Thailand. By reflecting on the goals and assumptions of the intermediaries and members of these platforms and how these were put into practice we observe key differences in their development.

In implementing the platforms, the facilitators and steering committees reflexively adapted the form and function of the platforms to align with the existing expectations and practices of cooperation in each of the countries. This resulted in three different 'TIP' models (see Fig. 1). In Bangladesh, the platform adopted a decentralized *convening* model that brought together a number of existing associations and demonstrated the value of cross sector collaboration. The outcomes here were emergent, albeit through a planned process of deliberation through which new technologies were developed, indicating the ongoing importance of membership based industry associations. In Vietnam we see a more planned approach to multi-stakeholder technology innovation platforms development that was characterized by a *hierarchical* model of planned participation. Here the outcomes of the multi-stakeholder technology innovation platforms were also planned to persist with no specific problem or goal in mind. The SRIA process was followed. However, this was informed largely through the network of EURASTiP members, rather than a broader range of stakeholders and led to policy outcomes in the form of better management practices. Finally, in Thailand we see a shift from planned participation to a fluid *networked* model that brought together different actors around specific problems. These networks were transient and focused solely on resolving a particular problem.

As demonstrated by the diversity in the form and function of each platform, the practice of translating TIPs was not simply a transfer of a design or approach from the EU (EATIP) to Asia. This can also be said of European 'mirror platforms' (i.e. national TIPs under EATIP) which are also diverse in their function and structure. What we see is that a range of factors influence this translation process which has consequences for the kinds of innovation the industry is likely to take on. We argue that while this process cannot be completely managed, the variation observed in the three national platforms indicates a considerable degree of reflexive decision making in the design of the platforms that emerges from the ongoing interaction of key actors in their specific socio-political context (see also Klerkx et al., 2012; Totin et al., 2018). However, we also note that reflexivity comes with challenges (or even dilemmas). Here we synthesize six design challenges from the three cases that hold wider relevance for the translation and implementation of multi-stakeholder platforms in Southeast Asia and beyond (summarised in Table 2).

First, membership can be more effective if initially built on existing relations rather than an 'objective' stakeholder analysis. While different to the democratic values in the EU prescription of open membership (see for e.g. Van Haverbeke and Cloodt, 2006), the existing networks of facilitators were effective in identifying and drawing in key stakeholders. For example, in Vietnam these networks were based on alumni networks of NLU, while in Bangladesh they were based on membership of existing representative associations. While these can be deemed as 'closed' (and therefore exclusive) networks (Lim, 2017), they played an important role in establishing a level of requisite trust in the initial stages of the platforms. As the three cases also show, over time these networks can be formalized in order to obtain legal status or legitimacy, or recognition from government. But as demonstrated in the case of Thailand, this formalisation does not have to come at the expense of maintaining a more transient membership model to enable dynamic problem-specific coalitions of actors.

Second, there is no one form of leadership that most effectively guides a multi-stakeholder platform. Instead a variety of leadership roles, ranging from coordination to facilitation are possible. Coordination can be defined as a more formalized mode of leadership which lends itself to planned innovation through the definition of working groups and the SRIA process, but risks focusing on planned rather than emergent outcomes. In contrast, facilitation can be defined as a more hands-off adaptive form of leadership that brings existing groups and/or key actors together to define their own innovation

Table 2
Characterization of ideal technology and innovation platform types by key design challenges.

Design challenges	Networked	Convening	Hierarchical
1. Membership	Members identified for each new 'problem' or innovation. Membership is transient, depending on goals of those involved`	Members determined by existing associations. Allows for national platform with decentralized sub-platforms. Membership is continuing	Members enrolled based on key stakeholder identification. Membership is fixed
2. Leadership	Facilitation of transient networks around specific issues. 'Minimal' secretariate focusing supporting capacities for problem identification and linking to key experts	Facilitation of linkages between established associations. 'Lite' secretariate focusing on inclusion, mobilisation and linkages between actors based on SRIA	Planned coordination by well resourced secretariate who sets clear goals, platform structure, and commonly agreed SRIA
3. Institutional positioning	Private sector led with recognition and support primarily from industry and secondarily from government	Private sector led with recognition and support primarily from convening representative associations and secondarily from government	Private or state led with support based on membership of industry and government
4. Demonstration	Validation key for building trust and reconvening networks around new problems or innovation processes	Demonstration and validation of innovations centrally important for building long term legitimacy	Demonstration of innovations used to support long term legitimacy of platform
5. Latency	Network based on high degree of latency, members mobilised in new networks configured around new problems	Low level of latency – ongoing representation of associations and other members ongoing, structured through national and sub-national platforms	Platform based on low level of latency – members stay involved on an ongoing basis through SRIA and technical committees
6. (Inter)national scope	International scope of technical, market, state and NGO actors enrolled around clearly defined problems or innovations	Domestic scope of members supported by international technical expert members, with links to international private sector actors	Domestic scope of members supported by international experts and private sector actors and NGOs

process (see Sørensen and Torfing, 2017). The type of leadership can also lead to different kinds of innovation. For instance, planned coordination can be effective in enabling transfer of technology and knowledge sharing (as seen in VINATIP), whereas facilitation can, when seen as legitimate by key actors such as government, enhance the capacity of stakeholders to adapt to changing circumstances (ThaiTIP), and develop latent webs of connections for possible future action (BATIP and ThaiTIP).

Third, there is no single 'first best' institutional positioning of multi-stakeholder technology and innovation platforms to ensure they gain and maintain legitimacy. While each of the platforms received support from the EURASTIP project, they had a different starting point by virtue of being led by an NGO, university and private company. This complicates comparison across the three countries. Nevertheless, what clearly emerges is the possibility for different actors to lead innovation processes and the need for a 'respected broker'. it is also clear from the results that these brokers need to be fostered – they don't simply exist (see for e.g. De Silva et al., 2018). There is therefore a need to develop the capacity of these brokers to negotiate vested interests in the industry; which can mean reinforcing the role of existing actors who take up this brokering role rather than necessarily inserting 'new' actors (see also Gliedt et al., 2018). Furthermore, contrary to the ambitions of fostering 'private sector led' innovation platforms (as was the ambition of EURASTIP), government is likely to play an important ongoing role; either in supporting the long term legitimacy of the platform, or funding and/or taking over some of the functions of the platform to ensure its long term sustainability.

Fourth, trust and legitimacy are closely tied to demonstration and validation. Following a long history of technology extension in each country, farmers, private sector and the government are assumed to value demonstration in the process of innovation. This in turn creates a paradox for multi-stakeholder technology and innovation platforms: demonstration is not possible without innovation, and without demonstration the trust necessary for innovation is not generated. The solution for two of the three innovation platforms was to start with external innovation; transferred from Thailand in the case of Bangladesh, and developed from a partnership between SFP and Stirling University in the case of Thailand. On the basis of the validation derived from these interventions trust in the platform was improved, which in turn strengthened stakeholder participation and demonstrated the value and relevance of the platforms to government and other private sector actors. Notably, trust was a less important factor in the case of Vietnam because innovation was instructed through the top-down authority of the state.

Fifth, innovation platforms can be created from new or by 're-energising' latent networks. As outlined above, each of the networks were based on pre-existing relations, some of which were established through the stakeholder mapping exercise, rather than immediately establishing new relations between unrelated actors. In doing so, the platforms tended to re-enforce existing networks. From one perspective, this reinforcement of existing relationships can create barriers that exclude new entrants to a process of innovation (e.g. Massey and Johnston-Miller, 2016). From another perspective, however, existing networks can establish the legitimacy of a new platform and in fact attract new entrants over time – as seen in all of the platforms. Exploiting these existing networks can also foster a degree of latency – i.e. an underlying set of relationships and capacities that remain unutilised until required (see Mariotti and Delbridge, 2012). As illustrated by ThaiTIP, this latency appears to have structured a transient network structure focused on targeted innovation coalitions that appear to be more effective in fostering innovation in the Thai context than a formalized long-term membership model.

Sixth, (and following directly in from the previous point) while domestic in focus, the boundaries of multi-stakeholder platforms will (and should) extend beyond national borders. The challenge for the intermediaries leading these platforms is to identify the extent to which networks of actors within their country are able to identify but also contribute to solving complex issues facing the aquaculture sector. While the capacity for problem identification is within these countries, it is likely that international networks, both within Southeast Asia and beyond, are needed to enable relevant knowledge and technology innovation (Lebel et al., 2016; Degelsegger-Márquez et al., 2018). This is perhaps best illustrated by the cost of pandemic diseases such as APHND, despite the interest and investment of major commercial concerns in all of the countries to which it spread (Shinn et al., 2018). As illustrated in the case of ThaiTIP and BATIP, solution-oriented coalitions of actors extending to a network of international expertise can enable effective targeted innovation. Likewise exchange, brokerage and education, facilitated by these platforms can also benefit from international linkages.

We argue that these six design challenges co-determine the type of multi-stakeholder technology and innovation platform. Steering the design, as far as possible, to (more or less) networked, convening and hierarchical types of platforms can foster either (more or less) emergent or planned innovation outcomes. For instance, planned innovation may be best fostered to different degrees through convening and hierarchical

platform types – placing greater attention on structured membership and using a SRIA, guiding a programme of shared knowledge creation. Emergent outcomes, in contrast, may be best stimulated through a networked structure with more transient international expert membership that enables demand driven problem solving.

Overall, the three countries, representing the different platform types, tended to address either planned or emergent outcomes, but not both. ThaiTIP, for instance, eschewed a planned SRIA process for a network structure that led to considerable activity in the network. In contrast, VINATIP placed considerable attention on the SRIA and BMPs as planned outcomes. The experiences of these countries indicate that while the choice for one approach over another is a function of many of the design challenges listed above, they should not be seen as mutually exclusive. The ideal types are instead likely pathways following from particular choices made in dealing with the challenges of setting up a TIP. This does, however, not preclude other pathways if different choices are made. In practice, both long and short term, planned and emergent innovation processes are likely to be essential for innovation platforms to ultimately be seen as legitimate and valued by the sector as a whole. The three ideal types and design challenges presented here are as such not prescriptive. They instead provide input for deliberation over the design and implementation of these platforms in other countries and regions that, we suspect, extend beyond the aquaculture industry.

6. Conclusion

The experiences of the three technology and innovation platforms confirm their potential for addressing a range of short-term production risks and even longer term goals of sustainable intensification. To understand this potential, we reflected on the process of translating a preconceived notion of aquaculture technology platforms, based on European experiences, into three Asian countries. Perhaps unsurprisingly, our overall observation is that the translation process is both dynamic and uncertain, as evidenced by the emergence of three different types of platforms in Bangladesh, Vietnam and Thailand. This has consequences for understanding the process through which technology innovation platforms are translated. It also implies that the development of such platforms should move away from a pre-determined model, as is implied by transferring a European aquaculture innovation platform model to Asia, to an adaptive approach focused on process and negotiation.

We also demonstrate that the dynamism and uncertainty hold consequences for the ability of intermediaries to reflect on and reflexively adapt to the wider economic, social and political context within which they operate. The six design challenges that intermediaries face in the translation process provide a starting point for being able to manage the development of multi-stakeholder technology and innovation platforms in an iterative, reflexive way that can align with the existing expectations and practices of 'multi-stakeholder' innovation in each country. Taken together these design challenges can provide a set of process-based guidelines for the conduct of intermediation which can help to resolve key decisions on the form and function of these platforms. For instance, whether they should be more or less hierarchical (closed) or networked (open), more or less inclusive and/or representative of a full spectrum of actors in a sector, or more or less driven by private sector or government.

These findings hold consequences for any future extension of aquaculture technology and innovation platforms to other countries and contexts. For instance, do the six design challenges derived from an Asian context hold relevance to Africa, where the majority of Innovation platform research has been conducted with a focus on small holder inclusion? The findings also hold consequences for the wider goals of the EURASTIP project in developing an EATIP equivalent 'Asian Aquaculture Technology Innovation Platform' or 'AATIP' and an ultimate bi-lateral 'European-Asian Technology and Innovation Platform' (i.e. EURASTIP). We conclude that establishing any of these platforms would require a shift from 'planned innovation' to 'planning for emergent innovation' that emphasises the development and support to the intermediation process. Furthermore, unlike the experiences reported on here, such an approach would require embedding reflexive evaluation throughout the lifetime of the project to enable ongoing learning and adaptation of the intermediaries and platform members alike.

Declaration of Competing Interest

None.

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