Lessons for R&D organisations and policy.

The innovation systems framework cannot answer how existing technologies on the shelves of research organisations can be transferred or replicated, because technologies are not stand alone items that can be transferred. It can, however, help policy makers think about how to put together the different pieces of information and the range of activities, organisations and individuals that must be involved in order to enable utilisation of these technologies in society.

The fact that innovation involves other socially embedded, non-technological variables and processes that need to be assessed, does not imply that R&D organisations should not estimate technical efficiency of pieces of equipment and other technologies they generate. In most cases, the CSOs, private enterprises, and financial agencies lack the technical expertise to understand or measure technical parameters. Scientific and technical expertise must play this role.

An R&D organisation however usually can not assess the way in which the technology will work in society unless it partners with others who have the additional information outlined in Table I. Quite often this information about local performance and the networks through which technology gets put into use can only be found out through trial and error. This suggests that an ex-ante appraisal is less useful than a process of continuous appraisal and adaptation. This might be thought of as an innovation assessment approach, features of which are contrasted with the conventional technology assessment approach in Table 2.

Table 2 Similarities and differences between conventional technology assessment and innovation assessment

Features	Conventional assessment of technology	Innovation assessment
Scope	Narrow emphasis on technology and non-specific to context of users.	Broad emphasis on technology use in society and specific to context of users.
Focus	Stand alone technology	Technology embedded in systems of use.
Who	Conducted only by experts	Conducted in consultation and collaboration with different stakeholders
Criteria	Fixed	Some assessment criteria likely to change over time depending on changing local conditions and agendas.
When	Ex ante	A continuous process of appraisal, adaptation and reappraisal
Assessment methods	Standardised and fixed	Incrementally improved through learning by doing.

R&D organisations need appropriate partners and perhaps it would also be useful to create an order of technically qualified entrepreneurs. – as TIDE has done who apprentice with them and become franchised dealers delivering TIDE's dryers to different users. Part of the solution to the larger problem is for R&D organisations to better appreciate the contributions of other organisations to innovation, especially contributions of private enterprise and CSOs.

R&D organisations in their drive for discipline-based expertise seems to have lost people who can work across disciplinary and organisational boundaries. SIFFS has overcome this problem by networking with and setting up appropriate advisory service forums with organisations and individuals with suitable expertise. When fishermen demand a change in design or ask SIFFS to address a problem such as safety at sea, it is these advisory groups who come up with further questions or appropriate answers -- some of which are policy rather than technical solutions

It could be argued that R&D organisations need not assess the sustainability of the technologies or the rural enterprises that use them, after all this could be left to CSOs or others. However another way to approach this is for R&D organisations to first decide on particular research themes and then to assess the impact of their work and to learn from local contexts about what works and what does not. This way the strategies and approaches of the R&D organisation could be continuously upgraded and the way they approach the question of assessing and validating technology could be modified and expanded through experience.

The question about why rural technologies generated remain on the shelves of R&D organisation, is ultimately one about ways of working in R&D organisations. Until they realign working practices with the reality of the multifaceted nature of the innovation process, technical and economic appraisals of new technology – however competently carried out – will not get those technologies moving off the shelves of research laboratories.

Some practical steps for R&D organisations are as follows:

1. **Do not take it all on yourself** – bring in other partners with specific skills to help understand and assess the technology and other knowledge and process inputs needed;
2. **Consciously cultivate modifications in habits and practices within the R&D organisation** – particularly those preventing R&D organisations learning from others, developing appropriate partnerships, and acknowledging that other partners are needed and can be trusted;
3. **Always assess the performance of the enterprise or household that uses the technology** – assessing the technical parameters of the technology is not enough;
4. **Cultivate personnel with multi-competencies and learning abilities** – internalising lessons learnt from each project or experiment;
5. **Consciously document and develop different ways of working to operate as part of a system of integrated support for the rural poor** – this will require much wider partnerships than is currently the norm.

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The next edition of the RIPWiG Reporter draws together the conclusions of this project
Comments and requests to info@innovationstudies.org

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RIPWiG Reporter

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Introduction

This is the third edition of the RIPWiG reporter. Its purpose is to share discussions from a policy dialogue group known as the Rural Innovation Policy Working Group (RIPWiG), an expert advisory group established by UNU-MERIT and its partners in India as part of a DFID funded research project "New insights into promoting rural innovation: Learning from civil society organizations about the effective use of innovation in development." The mandate of RIPWiG is to facilitate dialogue between the project team and decision-makers from Government and civil society organisations with responsibility for planning and implementation of science and technology-based rural development initiatives.

Right problem; wrong question. Rural development needs new technology, but how can R&D prove that these are efficient?

In this third edition of the RIPWiG Reporter, Dr. Rajeswari Raina from the Centre for Policy Research, New Delhi, addresses a conundrum set by RIPWiG. After hearing the research team present apparently successful cases of the use of energy efficient agro-processing dryers and new boat designs for small scale fisheries, RIPWiG asked "How did the technology users in these cases come to trust these technologies?"

RIPWIG went on to ask, "What did the R&D organisations do to prove that these were efficient technologies?", "Are the thousands of relevant technologies on the shelves of R&D organisations in India not being used because R&D organisations have not verified their technical and economic efficacy?" "Can the innovation systems framework used by the research team help draw a road map on how to promote other technologies that are currently lying unused?"

The research team argued that the question to ask was not about technical efficiency and performance -- although these are clearly important concerns. According to them, the key question was about how these technologies are put to use and this they argued was not just an issue of the characteristics of a particular technology. Rather it was about the characteristics of the systems through which technologies get put into use.

This edition of RIPWiG reporter presents that argument and illustrates it with two case studies of rural innovation involving fishing communities -- amongst the poorest social groups in India. To follow the research team's argument, it is first necessary to revisit the innovation systems framework that they have been using to analyse innovation processes.

What do we mean by..... innovation systems as an analytical framework?

The innovation systems framework is a way of viewing the world that recognises that innovation is not a research driven process simply relying on technology transfer. Instead, innovation, as a process of generating, accessing and putting knowledge into use is a much more complicated process and its precise form is often determined by local situations. Central to the process are the interactions of different people and their ideas, the social settings that shape these interactions and relationships and the learning processes that arise from these.

The other important insight from the innovation systems framework is that institutions matter. That is to say that the attitudes, routines, habits and practices and ways of working that shape the behaviour of the individuals and organisations, have enormous impact on whether or not innovation takes place (often relating to whether different people can interact productively) and whose agenda the subsequent innovation benefits.

While it is easy to dismiss these insights as nothing new in mainstream development thinking, the importance of these lies in the fact that this provides a framework linking two critical estates that have in many senses drifted apart. The first is the research establishment and its unshakeable belief that technology development (and transfer) is the way to solve the problems of the poor. The second is the development sector and its understandable disillusionment with the weak performance of science and technology as a driver of social and economic change.

The essence of the framework is the proposition that technology and other forms of knowledge can and do bring about the innovations (technical, institutional, market, organisational) needed for development. The framework argues that this will only take place, however, when the conditions are created for bringing different ideas and bodies of knowledge together, and when new ideas that emerge from this are put to productive use. The caveat being that the framework recognises that such arrangements will only meet specified social and economic goals (such as poverty reduction) if incentives and governance structures are in place that can steer innovation processes in this direction.

This perspective hints at the fact that if one wishes to promote innovation, it is necessary to look beyond the technical performance of new equipment and explore the local systems of use into which these need to become embedded – and therefore the networks of players involved. Not only do these systems set local criteria by which technology needs to be judged; but also the nature of the system needs to be part of the assessment as it will determine to a large extent the viability and benefits from a particular technology.

Technology as a component of innovation

Boxes 1 and 2 illustrate how technology is only part of the process of innovation. The cases also illustrate that since innovation is a locally specific process, this affects the way technologies are judged, and the need to assess and understand the wider system in which these are used.

In the first case on energy efficient dryers, the local context of technology use (self help groups (SHGs) of fisher women) meant that bio-mass based dryers were better than electric dryers -- even though these are technically superior. The reason being that poor fisherwomen lacked access to reliable supply of electricity. Not only were TIDE's bio-mass based dryers suitable to their context, but to allow use, TIDE created a system that produced this equipment commercially and helped fisherwomen to access different sorts of knowledge (technical, marketing and financing) that would allow a bio-mass dryer-based enterprise to emerge and grow.

The second case illustrates the kind of continuous technical changes that are required to sustain adoption of new technologies under continuously changing conditions. Introduction of plywood boats in the early 1980's addressed to some extent, the competition the artisanal fishermen faced from the introduction of trawlers. Though not efficient compared to trawlers, the plywood

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Box 1: Fish drying technology

TIDE (Technology Informatics Design Endeavour) is a small NGO in Bangalore. It draws upon the scientific expertise of the Indian Institute of Science, and centres like ASTRA (Association for the Application of Science and Technology for Rural Advancement). TIDE has enabled adoption of over 7000 fuel efficient of dryers among famers and small enterprises. In one of its projects, TIDE enabled adoption of bio mass based dryers to dry fish throughout the year. Fish tend to rot and get wasted during the rains. The poor woman in fishing villages needed an assured income. This initiative originated when TIDE found that electric dryers developed and tested by established research organisations did not work in the coastal villages where power supply was only available for a few hours a day. TIDE thus realised that there was a potential market for biomass based cabinet dryers.

TIDE found, however, that the introduction of this technology involved much more than the technical efficiency of the dryers – although that was also important. This can be illustrated by the other forms of assessment that accompanied the establishment of dryer based enterprise in the coastal village of Kodungalloor, Kerala. Members of a self help group (SHG) Parasparam (roughly meaning, one for all and all for one), first heard about TIDE's fuel saving cabinet dryer in 2001. They got interested in it because of the quality of dried fish produced and the scope for regular income by using this dryer.

TIDE actually demonstrated the new dryer by explaining how it had failed in another village. Its assessment was that improper SHG group dynamics, inadequate relationships with other stakeholders and poor information flows to and from the market were the reasons for this failure. Parasparam members, helped by TIDE, then began a series of consultations with organisations that would be important in the success of their enterprise. These included TIDE staff, a local NGO, Kudumbasree officers (State Poverty Eradication Programme), rural bank, masons and construction labourer, traders and suppliers, super markets and other local marketing agents, wharf workers and boat owners, fish processing scientists and technologists, packaging and labelling experts. The purpose of these consultations was both to assess the nature of the market as well as to make an assessment of how to develop linkages with these other players. With the help of TIDE the SHG also assessed its credit needs for the enterprise and assessed how this could be presented to banks in a way that it would be accepted – they included working capital in capital expenditure since this was the only item that Banks would fund in micro-enterprises.

Within eight months they had a biomass based fish drying micro-enterprise running successfully, providing employment and income. The 10 member SHG now knows how, where and when to procure, process, and market its produce, operate and maintain the dryer, and whom to call for each of these operations. It meets the norms set by Kudumbasree of providing a minimum of three days of full employment for each individual. They are now part of a chain of fish drying micro-enterprises, producing and selling a variety of dried fish products under the brand name Sagarshree (meaning wealth of the sea).

Assessment	Assessor
Generic technical and economic efficiency	ASTRA
Location specific technical and economic efficiency	TIDE
Quality of the product and income generating potential.	SHG with TIDE
Reasons for enterprise failure (group dynamic, patterns of relationships, access to market information)	TIDE
Procurement sources and product markets.	SHG with TIDE
Scope of stakeholders and actions needed to build linkages	SHG with TIDE
Credit needs and rules of Banks	SHG with TIDE

boats were appropriate to the context of artisanal fishing. Over the years, plywood boat designs were adapted to meet new needs, such as the need to cope with more powerful engines. In other words, the idea of technical efficiency was both specific to the artisanal communities needs and was a "movable feast" as needs and aspirations changed over time.

Both cases also reveal that technology adoption depends on changes in ways of functioning (institutional innovations). For example, in the TIDE case, SHGs that adopted dryers, found that to make this technology the core of a viable enterprise it was necessary to work with market intermediaries who could market their products for them. This they had never done before. Ways of working therefore need to be considered as a factor in the assessment of conditions needed for innovation.

The cases suggest that information about technology is only one of a rather diverse set of information needed to make judgements about putting technology into use. This suggests that it is not technology assessment, but innovation assessment that holds the key to understanding why robust technologies are not put into use. Five issues related to this observation seem to be important.

1. **Technical specifications are location specific and change over time.** There is no direct one-to-one transfer of pre-assessed technologies from the R&D organization to the end-user; for example, the plywood boats went through a continuous process of adaptation.
2. **Ways of working affect technology use and need to be understood and adapted.** The generation and utilisation of technologies occurs only when there are corresponding changes in ways of working (i.e institutional innovations); For example, in the TIDE case, the training programme of the Integrated Fisheries Project – a major public research and training facility – changed from conducting courses for processors and exporters of marine products in its headquarters, to conducting programmes for poor women in fishing villages.
3. **Specifications of networks and relationships.** Other pieces of knowledge and skills are located in a variety of organisations and individuals, and they come together to enable innovation; For example, in the SIFFS case, the presence of a well-knit network of manufacturers, suppliers, service providers, all accessible to and conversant with the fishermen's needs was crucial in the evolution and adoption of the new boat designs.
4. **Innovation assessment requires partnership.** Unlike the R&D organization's assessment of technological feasibility and economic viability, TIDE and SIFFS seem to assess directly and through their partners, a wide range of factors and the organisations and individuals associated with these factors (such as credit, price and affordability, transport, gender relationships, migration, processing technology, and marketing.)
5. **Poor people assess technology on multiple criteria.** Formal R&D organisations involved in these cases had almost perfectly efficient equipment; but these were not enough to convince the poor about the use of these. For example; the women members of the SHG where not attracted to the technical efficiency of the drying equipment. Rather they were convinced to use it because they saw it working effectively in their own environment and were able to see the quality of products, the demand for these in the local market and the potential for employment and income that could come from an enterprise based on this equipment.

Box 2: SIFFS and plywood boats

SIFFS (South Indian Federation of Fishermen Societies) is the apex body of organisations of small scale artisanal fish workers, representing more than 6000 artisanal fishermen, organized through over 1000 primary societies in eight districts of Southern Peninsular India. Set up originally in 1980 as a marketing and credit organisation, SIFFS has responded to emerging sector challenges by taking new and different responsibilities. These include: technology development and dissemination; boat building and repair: import and distribution of motors; running of ice plants; micro-credit; training for alternate employment; and policy research and advocacy.

One of the most successful activities of SIFFS has been boat building. It received the patent for plywood boat designs in 1982. It opened its first boat yard in 1983 and got professional help to develop its capacity to undertake boat building and design. It subsequently opened several new boat building yards to meet the increasing demand for plywood boats. These plywood boats have been widely adopted in South India.

The need to compete with trawlers and the availability of out-board motors in the early 1980's increased the demand for plywood boats. But the main reason for large scale adoption of plywood boats was SIFFS's ability to continuously respond to the fishermen's demands for modification in boat design (length, hull and add-ons like ice-boxes). SIFFS developed several new models such as plywood vallams (boats) and plywood tappa (rafts). With the recent increases in plywood prices, SIFFS is currently exploring the use of alternative materials such as fibreglass. SIFFS's R&D efforts are currently focused on ways of allowing fishermen to stay longer at sea. Iceboxes, sunshades and safety devices are undergoing trials as part of this effort. A new range of Vee-hull boats have also been developed to substitute the existing flat-bottomed fleet because of the problems associated with higher horsepower of outboard motors. With increasing operating and maintenance costs of the outboard motors, there is a renewed interest in diesel engines and SIFFS is currently experimenting with these. It is also developing new mechanisms to deal with safety and navigation issues.

User ownership and control ensure that fishermen are closely associated with the technology development initiatives. Besides providing ideas on user preference, it also helps in improving the fishing community's understanding of technological aspects. SIFFS thus creates a mechanism for production, maintenance and continuous upgrading of boat technologies.

Criteria for assessing technology and innovation.

Invariably, in all R&D laboratories, it is the technology as a stand alone item that is assessed for its performance under certain laboratory or field demonstration conditions.

Assessment of the technical efficiency and economic viability of a technology is now a pre-requisite for the release or recommendation of any technology by a Government agency in India. Yet, as the RIPWIG has pointed out, there are thousands of unutilised technologies on the shelves of R&D organizations. The cases of innovation analysed by the research teams such as the cases in boxes 1 and 2 reveal that civil society organisations (CSOs) who promote technologies among the poor rural communities, do not focus on assessing the technology alone.

In our examples here, SIFFS and TIDE, though very different in organisational formats assess the following:

1. the presence or absence of other actors who can supply inputs; maintain the equipment; provide finance; sustain demand for the product; and develop suitable policy and institutional arrangements.
2. the existence of local relationships, accountability and trust with these actors.
3. the economic viability, socio-cultural appropriateness, and overall sustainability of the enterprise or industry that will use the technology.
4. the ways in which the other partners in the system, including the end-user of the technology, can develop their collective capacity to introduce and use new technology.
5. the lessons that they themselves (as CSOs) have learnt from previous successful and un-successful cases based on a conscious reporting and discussion of how and why things worked or did not work.

On this last point on learning, both TIDE and SIFFS had experienced mistakes and failures from which they learnt lessons – and candidly discussed these with their partners (including end-users of the technology). For example; TIDE's reporting of the failed attempt in a neighbouring village and analysis of the reasons for failure; or SIFFS's assessment of plywood costs, increasing operational costs of outboard motors and design faults enabled all the partners and the users of the technology to see various non-technological aspects that were essential for the technology to fit into and be used in their own systems.

As can be seen, unlike the R&D organisation's assessment of technological feasibility and economic viability, these CSOs seem to assess directly and with their partners, a wide range of factors.

Table 1: Criteria of conventional assessment of technology and assessment of technology as part of the innovation process.

Assessment criteria	Conventional assessment by R&D organisation	Assessment of technology as part of the innovation process
Technological performance	Generic assessment of technical efficiency under test conditions	Technical efficiency, under user conditions with local material and inputs
Economic performance	Cost and returns of prototype	Costs and returns under user conditions, materials and inputs, with consideration given to opportunity costs of household labour and access to credit and costs.
Social fit	Based on assumptions about user contexts and preferences.	Suitability of modes of production to local social contexts of users; Preferences of different actors in the value chain for products.
Environmental impact	Generic assumptions based on test conditions.	Local environmental impacts assessed using impact criteria of local stakeholders, donors and governments.
Networks and other knowledge support structures	Not considered	Presence of patterns of interaction and inclusiveness relevant to innovation in specific technology-based areas of local activity.
Suitability of working practices of networks to enable innovation	Not considered	Presence of working practices that support partnering, networking, information sharing and learning.
Strengths and weaknesses of the enabling policy environment	Not usually considered	Presence of policies that will promote knowledge use and innovation: Product standards and other market regulation; intellectual property rights; availability of venture capital.

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