PLYWOOD BOATS IN SOUTH INDIA

One after another in the fishing villages along the lower south-west coast of India, a vast array of traditional craft are being rapidly replaced by colourful plywood boats which can be fitted with out-board motors. John Kurien describes this transition, which began as a ripple in 1982, and became a tide in 1995, with about 5000 new boats in operation.

Innovations do not spread in one smooth step: there are identifiable stages in the process. Initial inventive activity may lead to several innovations. Many factors may then encourage the adoption of some of these innovations among an initial group of potential users. A few of the adopted innovations may turn out to be commercially viable, and finally one or two may diffuse rapidly.

This article uses the plywood boat example to describe the dynamics of the process, from inventive activity to the rapid diffusion of the plywood boats (PWBs).

Figure 1: Ply vallum boat (stitch and glue), South India Credit: Practical Action/Paul Calvert

Invention to innovation

Major innovations are very often preceded by slow and continuous experimentation. This was the case with the launching of the first prototype plywood boat in 1982, which followed a decade of experimentation, initiated in 1973 through the Indo-Belgium Fisheries Project (IBFP). One of the first activities of the IBFP involved the training of youth from the region in boat-building skills. A boat-building yard was set up at Muttom, a fishing village at the tip of the Indian peninsula. But the good quality fibreglass (FRP) boats built as a part of the training did not interest the majority of the fishermen of the region, who used kattumarams and canoes for fishing. The boat-builders then began to make flat bottom plywood boats, but these did not arouse the curiosity of the fishermen either, since the boats needed mechanical propulsion and the initial costs were still relatively high. The boat- builders soon learned that although they could make quality boats, they could not sell them. Pursuing the 'prototype' approach to innovation diffusion without a keen understanding of the needs of the market contributes more to boat design history than to solving technological problems.

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The project soon restructured. The research and development (R&D) activities were split from the boat manufacturing activities. The latter was handed over to the trainee workers to be managed as a commercial venture, and was renamed Boat Building Centre, Muttom (BBC Muttom). The former became the Centre for Appropriate Technology (CAT) - reflecting the new understanding of technology in relation to society. The R&D initiatives at CAT were soon concentrated on finding an appropriate technological solution to fit the needs of the local artisanal fishermen.

Pierre Gillet, the Belgian engineer who initiated the boat-building project, recruited to CAT Mr. F.M. T. Raj, better known as Raju. Raju, an educated fisherman who had worked on the traditional crafts, had experimented on the new boat designs that were built before 1978. Together they set out to build a new craft to replace the kattumaram. The technological parameters for this new R&D venture were clearly laid out. Like the kattumaram, the new craft had to be unsinkable, light, and easy to operate from the surf-beaten beaches.

It had to provide more carrying capacity, be more comfortable than a boat powered by sail and oar, have a lifespan of 7 to 10 years, and be within the financial reach of the fishermen.

Box 1. Traditional Fishing Craft of South-west India

Until quite recently, fishing in south-western India was dominated by the small-scale or artisanal sector, characterised by simple, low-cost techniques combined with a high degree of skill and extensive traditional knowledge. A variety of timber nets, craft, nets, hooks, and lines were and are used, but today the influence of modern technology is readily apparent. Increasingly the outboard motor is replacing the sail and oar, nylon nets have replaced cotton, plywood and fibreglass boats are replacing timber, and small mechanised trawlers dominate the fishing harbours.

Traditional fishing craft fall into tow main categories:

The vallam or thoni
These are based on a hollowed-out log or dug-out canoe, are a often constructed with planks stitched onto the sides. They are found mainly in central and northern Kerela, where the larger are of continental shelf moderates the ferocity of the south West Monsoon surf.

This is the main craft type of South Kerela and the Kanyakumari District of Tamil Nadu, where the South West Monsoon surf conditions are the most severe. Literally a tied-log raft (in the Tamil Language Marram means log, and Katu means tied). It is constructed if light-weight timber logs (Albizia or Kapok) which are shaped and lashed together to form a very sea-worthy craft.

Figure 2: Traditional boats in South India. Credit Practical Action/Paul Calvert

Parallel to this development in CAT came an offer to the BBC Muttom from British naval architect Edwin Gifford and the Intermediate Technology Development Group –ITDG (now Practical Action) to build and test some prototypes of a new beach landing craft fabricated in marine plywood using a technique called 'stitch and glue' (see box). Gillet saw that this boat-building technology could be key to realising their own ideas, and accepted the Gifford-ITDG proposal.

Having mastered the new technology, the plan for the 'ideal' craft was revived. News of the new craft spread rapidly along the coast by word-of-mouth, and the cost of Rs7500 (in 1982 prices) seemed well within the reach of the fishermen. Firm orders from kattumaram fishermen was proof of this.

The instant success of the 'kottarkat' made BBC Muttom and CAT more confident and open to the requests from other fishermen using different types of traditional crafts. The next request came from fishermen who wanted a replacement for their dug-out canoes, as large tree trunks were in very short supply as a result of heavy deforestation. A plywood vallam (see photo) made using the stitch-and-glue technique was a possible solution. It would have to be stable, with good rowing and sailing efficiency, and be able to take an outboard motor (OBM).

By the end of 1982, BBC Muttom had designed a new plywood vallam and had outstanding orders for 26 kottarkats. The rising demand for the new boats was a reflection of both the technical soundness and the commercial viability of the boat yard. An old experiment was slowly turning into a successful innovation.

Promoting the innovation

The enthusiasm of the fishermen for the new plywood boats was also the result of several supply and demand factors not directly related to Muttom.

- First, there was the decline in the amount of fish landed by the artisanal fishermen between 1975 and 1980. The fishermen attributed this to the destructive fishing of the trawlers.
- Secondly, as a result of this perception, there were conflicts at sea, and trawlers were attacked. But artisanal fishermen felt that it was not enough to curb the trawlers, they had to fish better too. Mechanical propulsion was the only way to achieve this.
- Thirdly, the government's liberal 1980 import policy resulted in the availability of OBMs in the open market.
- Fourthly, the price of traditional craft spiralled because of the acute shortage of light wood and large trees. Fishermen who were still using the centuries-old craft design became more open to adopting new models and using new materials.

Commercially feasible

By early 1983, these macro conditions and the situation along the south-west coast region combined to really launch the PWB commercially. In fact the demand for the plywood boats brought with it a host of new, unanticipated supply problems.

The need for the present boat-building set-up to work commercially raised a number of questions: What institutional framework would allow expanded activity in the future? How should finance questions be resolved? Should the designs be patented to ensure that the new technology remained in the control of those

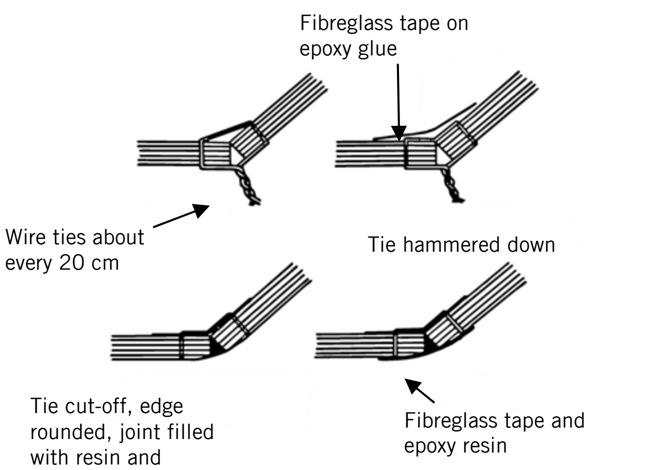

Figure 3: The plywood sheets are stitched together using wire ties and covered with resin and fibreglass tape

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who had the interests of the fishermen in mind?

BBC Muttom, CAT, ITDG, and Gifford discussed these issues with the South Indian Federation of Fishermen Societies (SIFFS), a non-government federation of fishermen's organisations. Following this the patent rights were transferred to SIFFS and they granted BBC Muttom the status of associate member, thus beginning a new form of more structured institutional linkages and initiatives to diffuse the technology. SIFFS opened a small boatyard in the fishing village of Alljellgo in January 1983, and started producing the first kottarkat models before specialising in the plywood vallams.

New inventions are never perfect at first, and may initially offer only very small advantages over previously existing techniques. The rate and extent of diffusion will therefore depend on the experience of the initial adopters, the availability of related complementary innovations, and the improvements made to upgrade the existing technologies.

Box 2 Plywood and boat building

Marine plywood is an extremely versatile and economic boat-building material, with the following characteristics:

- High strength-to-weight ratio because of the alternating direction of the grain in the veneer and compression forces, and means that thinner sections can be used, compared to traditional timber boat-building techniques.
- Great versatility, because it is not constrained by the shape and characteristics of solid trunks or wooden planks.
- Fewer seams or joints are required compared to planks, because of the large size of the basic sheets
- Plywood makes much better use of scarce resources than timber

Stitch-and-glue is widely used and simple
It was made famous by the Daily Mirror through the design for a kit boat for hobbyist sailors – “The Mirror Dingy”. In Kerala a number of industries manufacture marine plywood. The stitch-and-glue plywood technology requires the use of the same carpentry skills needed for traditional boat-building, coupled with skills in the use of fibreglass and resin system. The building system is very versatile and can be readily adapted to a variety of craft designs. It is, a technology which indigenous industries can use and which uses locally available skills.

To use stitch-and-glue technique plywood panels are cut to predetermined shapes, which are designed so that when their edges are joined, they pull together to form the hull shape. The boat designer needs to consider the most economical use of the plywood sheets. Cut-to-shape plywood panels are literally stitched together with wire ties (the panels having had their edges pre-drilled with holes to receive the wire ties). Ideally the wire used should be 18SWG (Steel Wire Gauge) galvanized soft iron wire. If galvanised wire is not available, however, then plain wire may be used, as it is finally covered with epoxy resin and fibreglass tape.

A good ‘Exterior Grade’ or ‘Marine Plywood’ must be used, so it does not delaminate when immersed for a long time in seawater. Ideally, plywood conforming to BS 1088 should be used, particular care should be taken to protect the exposed edges with epoxy resin and fibreglass tape.

The panels are held together by a very strong composite of epoxy resin and fibreglass rovings (bundles of fibres). This not only provides an extremely tough and resilient bond between the panels, but also results in a fully waterproof seam. An additional benefit is that the plywood edges are completely sealed too, protecting them from the elements. ‘Woven Rovings’ (a cloth of woven glass rovings – a roving being a bundle of very fine fibres) are the correct reinforcement and carrier for the epoxy resin. In India this is not available in tape form, the way it is in the North, so strips 1 to 2 inches (25 to 50 mm) wide are cut from large rolls of woven cloth. It is important to note that in fibreglass products dissolvable binders are used to hold the fibre together temporarily (for handing and cutting). This is particularly so with chopped Strand Mat (CSM). There are different types of binders too. Some are designed to dissolve in polyester resin, others in epoxy, so it is important to choose correctly.

CIBA-GEIGY Araldite AY103 + Hardener HY951 should be used for fibreglass work, and Araldite AW106 + HV953U for woodwork, or the equivalent epoxy systems.

After the main hull has been constructed in plywood, the frame, bulkheads, and thwarts, etc., are added using a durable boat-building timber (such as Anjele).

Just before their first monsoon, in May 1983, the kottarkats were showing signs of 'disease': the fibreglass tape was giving way, and cracks and leaks were appearing in the hulls. A drop in new orders was followed by a wave of cancellations. This brought panic. A crisis-management strategy was adopted to ensure quick repairs of all the affected boats.
An assessment of the situation highlighted the cause: an unanticipated use-pattern. The fishermen were using 7 horse power outboard[1] engines with the full crew sitting at the stern. The front of the boat was pounded on the waves, causing most of the damage. But the fact was that quality standards had also been lacking. The initial bad reputation earned as a result of the faulty craft was more than made up for by the repair campaign. The close interaction between the boat owners and the BBC Muttom workers during this campaign on questions regarding craft design, materials, and construction became an important component in the plans for new models. The crisis was thus turned into an opportunity, which led to design improvements which would not have materialised so quickly during 'the normal course of diffusion'.

Complementarity

The boat-builders did not realise the strong complementary role played by OHMs in the diffusion of PWHs. Their target was to replace 20 000 kattumarams, but in actual fact it was the number of kattumarams (and later canoes) that could be fitted with OHMs which was to decide the ceiling. In 1983 this number was a mere 200 units. In a sense, therefore, the diffusion of the OHMs. A single technological breakthrough rarely constitutes a complete innovation.

The introduction of new innovations also seems to result in immediate improvements in the old technologies. As OHMs were adopted much more quickly than the PWBs, the majority of the fishermen had to attach their new motors to their kattumarams and canoes. The vibration from the OBM strained the rope-lashed logs of the kattumaram and the coir-stitched canoes, so the fishermen improved the structure of their craft to reduce the vibration. These changes spread epidemically, and in one sense reduced the demand for the PWBs. Alternatively, it may also be seen as a process which smoothed the transition from a traditional technology to a more modern one.

While this factor may have retarded diffusion, the expectations of profits or larger incomes as a result of greater investment and better use of capital tended to promote it. An assessment of the economics of the operation of the plywood boats compared to the motorised and sail-powered kattumarams was undertaken in 1983. From the study, it was evident that both crew and owners of PWBs, who had paid 20 to 25 per cent more for their craft, earned substantially more than the crew and owners of the motorised kattumarams.

The commercial feasibility of using PWBs was thus established by the end of 1984, and because of liberalised import policies and financial support from banks, OBMs were more easily available in the market. The result was a sharp increase in the demand for PWBs:

- In the first three years of commercial production of the PWBs (1983-85) the order books showed a consistent range of 25 to 35 orders outstanding, with a waiting time of about five months.
- By mid-1985, SIFFS had established two new boat-yards to meet the growing demand. This helped meet the local requirements and resulted in product specialisation between BBC Muttom and SIFFS. Also by 1991, as many as 30 private facilities were building plywood boats, to meet the runaway demand. (A significant number of the small entrepreneurs were once workers in the BBC Muttom and SIFFS yards.) The barriers to setting up a new boat-building venture were minimal. The technology was simple, with minor requirements for both infrastructure and work tools. All the raw materials were readily available in the market and did not have to be purchased in bulk. In good weather a PWB could be built under the shade of coconut palms on the beach.

- By the end of 1991, a full decade after the first PWB was launched, there were about 2500 PWBs in operation. In the face of increased competition from the private sector, the combined market share of the BBC Muttom and SIFFS yards stood at 50 per cent. There was an exponential increase in the rate at which PWBs were purchased and built during the decade. Of the PWBs in operation in 1991, it took 4.5 years to supply the first 600 boats. The second 600 were built and sold in another 2.2 years. The third and fourth lots of 600 entered the fishery even more rapidly - in 1.5 and 1 years respectively.

'In search of a drawing' was the title Pierre Gillet originally gave to his personal reflections on the effort he made between 1973 and 1987 to build an appropriate boat for the traditional fishermen of the region[2]. With over 600 plywood boats crossing the surf today (May 1995) there is no doubt this search has met with considerable success. Not one, but many drawings have been made. The innovation process continues unabated, with the numerous models designed over the years making it possible to talk about a genealogy of plyboats in a matter of a little over a decade.

Lessons Learned

Many lessons about technology transfer and diffusion were learned from this experience. The transfer of technologies from foreign lands, using non-local experts, is not necessarily inappropriate in itself. What makes it so is often the manner in which technologies are introduced - without reference to what already exists. To prevent a mismatch, close interaction between users and technology generators is a prime requirement for introducing productive technologies into traditional societies. Even such participatory methods, can still lead to sterile R&D of little practical significance or socio-economic relevance however, if the supply and demand for innovation is not understood. To make an innovation commercially feasible a variety of issues need to be carefully addressed: proper infrastructure and institutional support; finance; issues regarding patents; and the ability to respond quickly to crises, to name a few. Being equipped for these challenges requires a degree of organisational flexibility: the path to new technologies is not a smooth, even, line.

Improvements in the existing technologies, the slow development of complementary innovations and temporary, unanticipated set-backs in the new technology cause 'friction' which hampers the diffusion process,

So how will the diffusion of the motorised plywood boat affect the future of the fish economy of the lower south-west region? The plywood boats have become an integral and indispensable part of both the technical apparatus of the small-scale fishery and the local economy. Whether this will spur fresh demands for new boat designs, boat-building materials, or any other technological and institutional changes, only time will tell.

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