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**Theme 6: Accelerating Skills Transfer**

**UPLIFTING DEVELOPING COMMUNITIES THROUGH SUSTAINED TECHNOLOGY TRANSFER**

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**ABSTRACT**

*Technology Transfer (T<sup>2</sup>) Centres have become a very important medium in the transportation sector both nationally and internationally especially with regard to bridging the divide between technology development and its practical implementation. Since October 2002, the Council for Scientific and Industrial Research (CSIR) Built Environment has been host to one of three T<sup>2</sup> Centres in South Africa (the other two are housed at the South African National Roads Agency in Pretoria and KwaZulu-Natal Department of Transport in Pietermaritzburg). The CSIR chapter was established in collaboration with the United States Federal Highways Administration (FHWA), with the primary objective being to identify the needs of the transportation sector with a view to facilitating the provision and dissemination of technology, policies, practices and procedures, as well as technical skills and expertise to the wider transportation community in southern Africa.*

*With the help of some practical examples, this paper seeks to highlight the importance of technology transfer, not only in stimulating innovation, but also in broadening livelihood opportunities as well as in strengthening local institutions. A strand of thought that runs through the paper is that as the gradual shift to a knowledge society takes shape, even in developing rural environs, knowledge becomes an entrenched production factor. In this regard, continuous learning processes are considered pivotal for the successful performance and adoption of technologies. A final conclusion is also evident – in order to ensure sustained impact from technology transfer and adoption activities, the ultimate metric is participation as encapsulated in the old Chinese adage "Tell me and I will forget. Show me and I will remember. Involve me and I will know".*

**1. Introduction**

Technology Transfer (T<sup>2</sup>) Centres have become a very important medium in the transportation sector both nationally and internationally especially with regard to bridging the divide between technology development and its practical implementation. Since October 2002, CSIR Built Environment has been hosts to one of three T<sup>2</sup> Centres in South Africa [the other two are housed at the South African

National Roads Agency in Pretoria and KwaZulu-Natal Department of Transport in Pietermaritzburg]. The CSIR chapter, which is seeking to be a centre of excellence and a purveyor of best practices, was established in collaboration with the United States Federal Highways Administration, with the primary objective being to identify the needs of the transportation sector with a view to facilitating the provision and dissemination of technology, policies, practices and procedures, as well as technical skills and expertise to the wider transportation community in southern Africa.

Another key role of the CSIR T<sup>2</sup> Centre is as a clearinghouse for transportation information. In this regard, the centre is currently on a drive to source diverse transportation materials. Information dissemination is also by way of workshops, seminars and regular training and capacity building activities. In addition, strategic relationships and alliances, including joint activities with other T<sup>2</sup> Centres and with institutions of higher learning i.e. universities and technical colleges, as well as professional institutions, such as the Asphalt Academy, are in the process of being established.

## **2. Rationale for and definition of technology transfer and adoption**

The transfer of technology, or extension as it is often referred to in a rural context, involves "the moving of technical knowledge, ideas, services, inventions and products from the origin of their development (or other location), to where they can be put into use" (Guerin, 1999). In other words, technology transfer refers to a range of activities that involve researchers, technology users, and technology transfer specialists [TRB, 1999]. Activities include, among others:

- Identifying innovative technologies
- Selecting and prioritising technologies to be promoted
- Adapting, modifying and packaging the technology for use in its new environment
- Determining, developing and applying effective technology transfer methods
- Continually modifying the technology transfer process in accordance with feedback on which technologies and which methods of technology transfer have been successful

Indirect or passive technology transfer involves the exchange of knowledge through such activities as informal meetings, publications, workshops and conferences.

The flip side of the technology transfer coin relates to technology adoption, which refers to the implementation of this transferred knowledge about an innovation (Guerin, 1999). Clearly, as the ultimate goal of technology transfer, successful technology adoption is a key necessity for the sustainability of benefits associated with technology transfer.

It is common knowledge that research reports are often highly technical, providing little guidance to aid potential implementing agencies. Technology transfer programs can and should fill this gap by providing information at different levels of abstraction for different audiences, as well as technical assistance, user training, and financial support for implementation efforts.

In addition, and particularly in rural areas, where economic and livelihood activities are largely influenced by government, technology transfer and adoption can play a significant role in unleashing innovation, the spirit of entrepreneurship, as well as strengthening local ownership. Furthermore, local agencies such as district municipalities, which are often hamstrung by limited knowledge of innovative new

technologies, a lack of funds for initiating programs involving such technologies, and limited technical expertise to assist in implementation, could benefit tremendously from technology transfer and adoption activities.

### **3. Participation and procedural justice**

The role of user and community stakeholder participation in technology transfer initiatives is widely deemed important especially with regard to the adoption of technology and innovation. However, in recent years, the adequacy of dominant processes of participation in public policy and decision-making has come into sharp focus (Joss & Brownlea, 1999). The key role of science and technology in shaping society, and widening the boundaries of knowledge as well as the scope and range of technological applications, has led to the highlighting of public policy and decision-making processes in science and technology, which now more than ever, bears significant strategic importance in government policy (*ibid*).

Among the challenges that have arisen with respect to forging new policy and decision-making processes, is the question of how to achieve public legitimacy in the face of “dissenting social factions and an apparently growing public distrust in government” (Joss & Brownlea, 1999: 322). The introduction of various tools and new legislation, such as strict health and safety regulations, the appointment of ethics commissions and, in some cases, increased public access to decision-making processes, have in principal been aimed, *inter alia*, at making knowledge and decision making more fair, more accountable and more competent (by extending the basis of knowledge) (Joss & Brownlea, 1999). Yet not all of these tools have yielded sufficiently successful results (*ibid*). Furthermore, in the face of new forms of public participation in decision-making and political interrogation, such as various forms of public consultation, debate and participation, the means by which to assess the functioning of these tools remains elusive (*ibid*).

Given the above challenges and emerging characteristics of the global village, there has been an increasing search for public policy and decision-making processes which respond to the concept of procedural justice. The term “procedural justice”, with its roots in several schools of thought, including legal sociology, social psychology and jurisprudence (Joss & Brownlea, 1999), relates broadly to “the fairness of the process by which decisions are arrived at” (Kim & Mauborgne, 1995, cited by Joss & Brownlea, 1999: 323). The need for procedural justice, according to Tyler (1993, 1994, cited by Joss & Brownlea, 1999), has developed particularly in relation to increasingly modern, pluralistic societies. By this, Tyler refers to the ways in which modern societies, due to diverse value systems and a relative lack of generally agreed standards for reaching decisions have become compelled to look closely at the ways in which decisions are arrived at (*ibid*). The processes of decision-making thus become important in determining the legitimacy of decisions arrived at (*ibid*); participation and decision-making processes are no longer viewed as simple or neutral, but as complex and functionally related to knowledge production, effective implementation and social justice.

A key question arising with respect to procedural justice in science and technology has been around the normative values and statuses given to different potential stakeholders. One of these relates to the need for a critical examination of the rationale behind technocratic modes of decision-making, in which professional experts are regarded as rightful principal actors in decision-making processes around science and technology (Joss & Brownlea, 1999). Thus, a move is beginning to occur away from technocratic, hierarchical knowledge and decision-making paradigms. The successful adoption of technology among intended users can, in this respect, no

longer be viewed as solely contingent upon the knowledge and expertise of professionals, but upon the meaningful participation of users and community stakeholders. Similarly, factors inhibiting technology adoption by users cannot be seen as resting at the foot of users alone (their fear, their education levels, their unwillingness to take up innovative solutions) but also as related to the *processes* by which intended users are engaged.

The cornerstone of the procedural justice concept is that there is “a functional relationship between decision processes and decision outcomes”: those affected by a decision are more likely to accept and endorse it if they perceive the decision-making process to be fair (Joss & Brownlea, 1999). Furthermore, the perception of fair process in decision making has been linked to a developing trust in the decision-making institution or model over time (*ibid*). Thus, the concept of procedural justice and the questions it poses are inextricably linked to factors facilitating or inhibiting technology adoption.

#### **4. Technology development, transfer and adoption participation processes**

Even in cases where the importance of public or community participation is generally agreed upon, the extent and nature of participation, and its relationship to ethics, remains disputed. One of the arguments made with respect to user participation in technology development, transfer and adoption processes, has been that these processes should begin with the intended users of the technology as the starting point for any initiatives. Thus, in order to maximise technology uptake, research problems should match users’ needs (NCHRP, 1998). For this reason, intended users of technology innovation should also participate in the processes of technology research selection from the outset, and contribute to the prioritisation of research efforts (*ibid*). Participatory Action Research methodologies attempt to achieve such seamless partnership between researcher, practitioner and user. However, a question remains around the level to which intended users should define the scope of and criteria for innovations. Chess and Purcell (1999), for example, point to the need for a synthesis between participants’ criteria and theoretical criteria, as identified by researchers.

Early beneficiary and community stakeholder participation promotes technology adoption by helping to identify technologies which communities will regard as relevant and beneficial, and which will thus speak to users’ needs more directly. Understanding user needs, as well as exploring user priorities and potential motivation and resistance factors, provides a clearer vision for implementation-driven research. Clearly, early involvement introduces community ownership of, and active participation in, the project from the outset. As confirmed by Chess and Purcell (1999), introducing participation early and investing in advance planning play a significant, if not decisive role in technology adoption. The opposite is also true – when ideas are presented in advanced stages to community stakeholders, for example, by asking stakeholders to consider an agency’s proposals, the risk of a reactive response is ever present (*ibid*). In this regard, community stakeholders feel acted upon, rather than feeling like *actors* in the process from the inception of participation.

Clear goals should also be set – in collaboration with community stakeholders – for innovation research, and these goals and associated benefits should be communicated to all parties involved (NCHRP, 1998). Well-defined and promoted goals, with easily recognisable and clearly communicated advantages, can contribute to the adoption of technologies (*ibid*).

As important as clearly defined goals, is the clear communication of goals, as inferred above. A lack of communication – including up to date information for community stakeholders with respect to the processes of technology research, transfer and adoption – as well as a lack of understanding of the nature of the benefits and risks involved with an innovation being considered, have been identified as potential adoption inhibitors, likely to result in resistance to change (Guerin, 1999). People are more likely to take calculated risks when they have a good understanding of the circumstances and associated risks around a new technology, and when they are able to compare the benefits of a new alternative with the “old” technology (Jedlicka 1979, cited by Guerin, 1999). Furthermore, as Joss & Brownlea (1999) pointed out, perceptions of fair process, in which good communication strategies and public input processes throughout could play important roles, affect the outcome of decision making processes.

The modes through which communication is achieved are also important. Guerin (1999) points out that certain agencies still tend to rely on the written word for information collection and dissemination, while rural land users, for example, may rely mostly on visual and verbal messages. Furthermore, they argue that limited adoption of land management research has often been caused, at least in part, by communication that does not reach community members due to the fact that it lacks site and season-specific information and considerations. The need to localise the types of knowledge, and ways in which communication takes place, is thus crucial (*ibid*).

Participation from the early stages should not only be confined to community stakeholders, but should also extend to the research community and other experts in various disciplines with cross-cutting relevance to the project. Through cross-discipline collaboration, resources can be shared towards the testing, validation and implementation of a new product or process (NCHRP, 1998). Furthermore, collaboration can contribute towards the fine-tuning of a product on different levels (*ibid*), and towards the identification of various factors not yet addressed by the core research team. Finally, collaboration can also occur between the research agency and an outside research-oriented organization in the public or private sector – for example a technology transfer centre – towards the promotion and implementation of research findings for the entire industry (NCHRP, 1998). The practice of having consortia of research producers with formal or informal alliances across various disciplines is common in many parts of the world. Additionally, forming an advisory committee to guide the research and the technology transfer effort, which includes membership of all stakeholders, can achieve such level of collaboration that is so critical to the success of the effort.

However, broad participation and collaboration comes with its own set of challenges. Joss and Brownlea (1999) raise a critical question in relation to this: is procedural fairness universal? If participation of and collaboration with various stakeholders at various levels is needed for the successful adoption of relevant technologies, issues around varying perceptions of procedural justice would need to be addressed. In different contexts, various stakeholders are likely to have different expectations from the participation process, both in terms of the level and nature of their participation and decision-making powers. These varying expectation arise from *inter alia*, social, cultural and economic positions and values. This again also needs to be weighted against what Joss and Brownlea call “distributive justice”, which refers to the fairness of the decision in terms of the allocation of resources, benefits and risks amongst various participants (1999).

Guerin (1999) point out that “opinion leaders”, or individuals in a community with an influence over the behaviours of others community members, play an important role in terms of influencing land users in the adoption of decisions. Guerin (*ibid*) thus point to the need for extension agents to identify such opinion leaders and undergo due protocol and consultation with them regarding potential innovations. Those leaders become the technology transfer champions who consistently advocate for change and strive to break down the barriers and resistance to innovations. They furthermore suggest that communities without sufficient internal leadership may be slower to adopt a technology (*ibid*).

Given that technology adoption among rural communities is a complex process, it is not surprising that technology transfer initiatives do not always result in technology adoption. Previous studies in land-use extension have pointed to the multi-factorial nature of non-adoption (Guerin & Guerin 1994; Vanclay & Lawrence 1994, cited by Guerin, 1999). Another identified set of factors involves the characteristics of stakeholders to whom technology is being transferred. These include factors such as personality, education level, and degree of motivation (Guerin, 1999). Other relevant personal attributes of community stakeholders include beliefs, values and fears (*ibid*). Bangura (1983, cited by Guerin, 1999) found that, in relation to land users, the best predictors of adoption were land users’ individual goals. Technology transfer and adoption models thus need to tap into the needs of users, as well as build upon and strengthen stakeholder motivation towards the uptake of innovation.

Another identified inhibitor for stakeholder motivation includes negative past experiences with the introduction of new technology (Guerin, 1999). These negative experiences can lead to indiscriminate rejection of innovation by community stakeholders, resulting from a “learned helplessness”, in which individuals and communities perceive their adoption behaviour as making no difference to the final outcome or level of production (Guerin & Guerin 1994, cited by Guerin, 1999). The above highlights the importance of careful and rigorous implementation strategies for adoption, as well as the need for knowledge relating to locally specific potential adoption inhibitors, such as beliefs and experiences.

However, Joss and Brownlea (1999) point out the emerging need to examine not only individuals, but processes. Procedural justice would require that intended users and participants not merely be seen as potential resisters of change, but that they are viewed as important sources of knowledge, and indeed integral actors in processes of technology transfer. In other words, discourses and practices that suggest that intended users just need to be “convinced” of the efficacy of intended innovations are likely to fall short. Furthermore, a question raised in relation to procedural justice relates to the need for local adaptation of “fair process” (Joss & Brownlea, 1999). As in cases where particular political, social and economic dynamics call for the greater participation of specific community leaders in innovation initiatives, the need for local knowledge and adaptation is ever present.

## **5. Sustainable technology development and flexibility**

The contribution of Marjoljn et al [2001] to this polemic has been to question the flexibility of wider technological systems especially those that are deeply embedded in society with a view to generating strategies and options for taking into account and enhancing their flexibility in the development and implementation of new technologies.

Flexibility concerns the extent to which a specific technological system is appropriate for, or can be adapted to changing circumstances. Adaptation of the system can also

include replacing products, materials or technologies. Marjoljn et al (2001) cite the bicycle as an everyday example of a very flexible technology, since it is used as a part of a very different transport system, since different types exist for different purposes and since it can rather easily be replaced by other means of transport in many applications. In this case, the change of circumstances mainly refers to a change of transport system. Changing circumstances may also involve development of new knowledge in the same fields.

## **6. Innovation and technology transfer and adoption**

Generally, innovation is aimed at lower cost, higher quality, or improved performance. In the transportation sector, innovation is important because it can help improve performance and safety, reduce environmental impacts, and reduce costs for the construction, operation, and maintenance of transportation infrastructure. "Whatever else may be involved, innovation only occurs when ideas are used; i.e. it must include deployment...and use" [Kash 1989, p.24]. In other words, successful innovation requires implementation. Achieving innovation is a complex process involving many people and activities, with the ultimate aim of implementation and use of research products in an operating environment.

Participants in the innovation process often provide new technologies, important feedback on implementation experience, new ideas for additional research, and assistance in fostering more widespread application. This is indeed clear from the examples of technology transfer projects chronicled elsewhere in the report.

## **7. Impediments to innovation**

Change, improvement and innovation based on research are important to the transportation industry. Developing and implementing innovations through research is primarily a public sector activity, although it is often undertaken in conjunction with private sector members of the industry – largely because of public sector ownership and management of the system (TRB, 1999). While innovation involves risk, public sector decision-makers work in an environment that does not reward risk taking (Jacobs & Weimer 1986). Public officials prefer familiar solutions that limit unexpected consequences. If they are unfamiliar with a new technology or uncertain about its benefits, they are reluctant to use it. In addition, procurement is often legally bound to a low-bid approach in which the emphasis is on design specifications rather than performance specifications – an approach that indeed discourages bidders from offering innovative alternatives.

Public sector procurement activity is driven by a low-bid process based on specifications and procedures established to satisfy the need for open competition and accountability. Clearly, these procedures often discourage contractors with new processes or products because specifications often determine how facilities are to be built, the types of materials to be used, designs to be followed, and construction processes to be applied. New technologies or materials with the potential for improved performance may not meet existing design specifications. Thus, attempts to introduce innovation and reduce life cycle costs can be stifled. In addition, Jacobs & Weimer (1986) contend that in a procurement environment dominated by selection based on lowest initial costs, the private sector is not motivated to invest in research and development if it cannot retain the ability to capture the financial benefits of the research products.

## **8. Good practice examples**

## **8.1 Community-based labour-intensive tourism infrastructure and services development**

The strategic approach to tourism in South Africa is guided by national priorities of job creation, economic growth, poverty alleviation, a better living environment, nature conservation and the promotion of the African Renaissance. For developing communities though, the key objectives of tourism-led growth are to generate sustainable socio-economic growth and development by way of exploiting opportunities that arise from new tourism, cultural and eco-tourism development for the creation of up-stream and down stream business opportunities, especially small enterprises owned and operated by previously disadvantaged communities. However, developing rural communities are characterised by:

- ❑ Poor and/or inadequate access to transportation infrastructure, services and financial resources
- ❑ Weak institutional frameworks
- ❑ Weak skills base including entrepreneurial skills
- ❑ Insignificant business sector presence
- ❑ High levels of poverty and unemployment

CSIR Built Environment has been assisting the local communities of Cwebeni, Bholani and Hlamvana situated in the Port St Johns Municipality, O R Tambo District, Eastern Cape Province (where conditions described above prevail), to construct a cultural village and an indigenous foods restaurant (Mashiri, 2005). When completed, the cultural village and the indigenous foods restaurant, which are designed to blend in with the existing village morphology, will showcase Xhosa culture and cuisine as well as offer entertainment and overnight accommodation for visitors. The project also involves the construction of approximately five kilometres of an aesthetically pleasing and appealing hiking/biking trail employing community-based, labour-intensive methods both as an attraction in its own right and as a means to access other activity areas. By improving drainage and building retention walls on the trail, which follows existing paths, the project has aided environmental conservation efforts and enhanced community awareness around preserving the environment.

The project involves extensive training of beneficiary communities in a wide range of areas, from labour-based construction methods to general life skills. Local communities are now able to articulate their needs and their aspirations through participation and ownership of the process of development. It also entails extensive and sustained participatory processes involving beneficiary communities, provincial, district and local authorities, traditional authorities, the private sector, community-based and non-governmental and quasi-governmental organizations.

The main project objectives are to:

- ❑ Mobilize beneficiary communities around the project and other development issues
- ❑ Create a significant number of short-term employment opportunities during the construction period and a few permanent ones afterwards
- ❑ Create community assets i.e. a cultural village, an indigenous foods restaurant and hiking/biking trail, which will broaden the tourism experience of this part of the Wild Coast
- ❑ Facilitate local economic development and mainstream the local economy
- ❑ Build a platform for socio-economic transformation and widening choices for livelihood opportunities
- ❑ Train and build capacity in various fields
- ❑ Transfer community-based labour-intensive technologies



- Generate an innovative community-based business development model
- Facilitate the development of ancillary activities (with the project acting as an anchor around which to build a local economy)

This technology transfer project has since its inception, created a cadre of community members who are sensitized to and galvanized around the importance of developing their indigenous resources to attract tourists, and who are now committed to exploiting opportunities in the tourism industry for community socio-economic benefits. Although the extensive process of consultation that constituted an integral part of the project, is time-consuming and perhaps even tedious, it is a most sustainable route to follow to ensure stakeholder buy-in and early adoption of technology. CSIR Built Environment is currently crafting a community-based business development model that emphasizes a win-win scenario between the community, private capital and the public sector i.e. community-public-private partnership. Furthermore, a cadre of relatively skilled construction “contractors” who can be relied upon to undertake repair work and other municipal construction activities has been painstakingly nurtured.

It is of interest to note that although the area has great agricultural potential, very little agricultural production has been taking place overtime. For example, most vegetables that are consumed in Port St Johns come from outside the province. Thus, this technology transfer project and the resulting assets have spawned other livelihood activities, for instance, beneficiary communities will be producing and processing indigenous crops, herbs and medicines to buttress their food and nutrition security and for consumption by visitors. Technology transfer activities thus awaken dormant communities’ productive and innovative capacities.

Meaningful technology transfer invokes a sense of and hope for a better future. Communities galvanized and primed in this way become a ‘hot bed’ of innovation themselves, as their creative juices and entrepreneurial spirit are unleashed, using as a base, indigenous knowledge embedded in their collective psyche, but which has hitherto been lying dormant and somewhat repressed. In addition, technology transfer becomes a platform for cultivating a meaningful relationship between the community, the public sector (especially the local authority) and traditional leadership based on common goals crafted around the technology transfer project. The project has also been used as a platform to build local institutions, strengthen entrepreneurship, leadership and entrench community cohesion as well as stimulate innovation and enterprise as evidenced by, for example, viable community-based institutions such the Umanyano Trust, Projects Steering Committee, and others.

Given the hilly terrain, stone pitching and gabion baskets, for example, have been used to improve drainage, reduce the spectre of landslides as well as to induce the community to effortlessly and seamlessly learn about general environmental conservation. These are skills that locals have begun to employ in their own environs on a day-to-day basis. Besides the path construction skills, communities have also learnt durable housing construction technologies complete with thatching techniques. A new metric standard is therefore being set that locals aspire to achieve for themselves.

The success of this project is credited to a technology transfer vision and strategy that strove to achieve strategic alliance of interests among all stakeholders. Technology was adapted and modified to fit the specific and unique needs of the host community. It built its foundation on the assets that are already present in the community, and avoided the blind transfer of technologies that are not suitable or

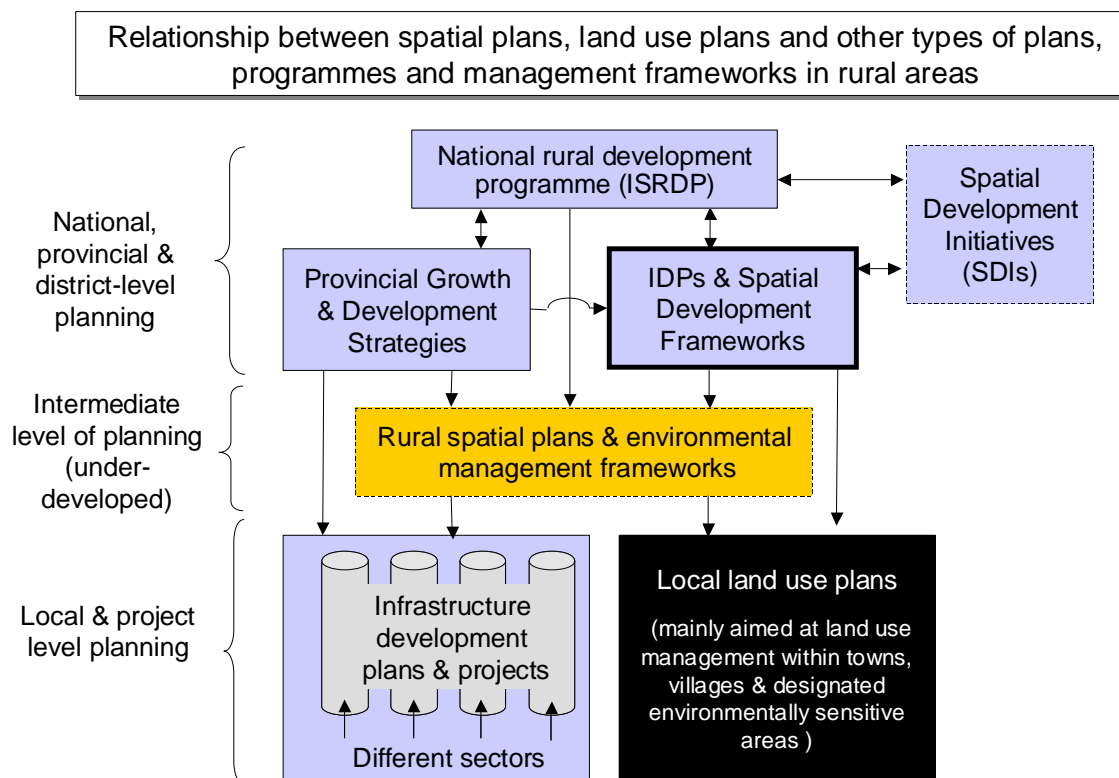
appropriate to the local landscape and which therefore cannot be sustained.

## 8.2 Community-based land use planning and management

As illustrated in the diagram below, land use plans are intended to support the implementation of municipal or district spatial development frameworks (Mpondo et al, 2004). These frameworks – which are developed as an integral part of municipal IDP processes – are, in turn, the main vehicles for integrating and localising national, provincial and sectoral development plans. However, most of the spatial development frameworks that have been developed for rural areas are far too general and static to ensure coordinated spatial targeting of infrastructure and service delivery. A related problem is that these plans or frameworks are usually not sufficiently binding on, or informed by, the infrastructure development and facility location plans of higher-level government departments. In order to address these shortcomings, there is a need for strengthened rural spatial planning and environmental management at an ‘intermediate level of planning’.

The major objectives of this technology transfer project were to:

- Equip stakeholders with land use planning skills, including the development, implementation and continuous updating of land use plans through training workshops
- Develop and implement land use plans for selected sites in the Wild Coast through sound planning principles underpinned by an inclusive, participative and flexible approach, assisted by villagers trained in the land use-planning workshops
- Provide targeted technical support to government officials and other relevant stakeholders in the formulation and implementation of environmentally sensitive land use plans for the Wild Coast underpinned by creative and interactive management systems



Lessons learnt in technology transfer activities of this nature include the following: Throughout the workshops, participants showed a lot of enthusiasm and passion for land use planning and management. The plenary and group discussions were animated. Even fairly mundane planning legislation issues were enthusiastically discussed. Participants were attentive and asked very pertinent questions. The hunger for knowledge was indeed apparent. This can also be gleaned from their glowing comments about the workshop. It was thus apparent that after the workshop, the participants would make use of their newly acquired knowledge for the benefit of their communities particularly in their engagements with developers both from within their own ranks and from the outside, which does justice to the old adage:

While knowledge is **power**, sharing information is **progress**

However, while the approach that was employed, i.e. first harvesting the communities' indigenous knowledge and then relating it to the formal planning precepts worked well in terms of cross-fertilization of ideas, it was clear that the workshop would only be scratching at the surface with regard to the subject area of land use planning and management. The intention was therefore not to overload and saturate participants with information. Given the varying levels of education and understanding of the participants, the focus was then to deliberately and unhurriedly channel them into the subject area, using as a cornerstone, their indigenous knowledge. This was fostered through probing questions, intensive group work and the introduction of a limited dose of substantive land use planning and management concepts. For all intents and purposes then, this training workshop was more for awareness building than to disseminate substantive theories around land use planning and management. This suggested the need for follow-up workshops to:

- Evaluate whether the planning principles shared in the first workshop had been assimilated and were being employed in community daily activities as well as contribution to the Ward Development Plans
- Seek to unravel and deepen the planning principles and issues that were introduced in the first workshop
- Introduce new land use planning and management concepts at a much higher level of abstraction
- Lastly, strengthen and entrench land use planning and management with a practical demonstration project.

It is also important to make mention of the fact that follow-up workshops also need to include decision-makers such as the traditional leadership, the Ward Councillor and local authority officials. The rationale being that now that the community represented by the participants are now very much aware of planning and management issues in their community, they would be able to engage the decision-makers much more meaningfully and discuss planning issues much more knowledgeably. It could also provide them with ammunition to insist on transparency and accountability in land use planning issues and management, which would also entail, on their part, accepting more responsibilities in governance issues.

Lessons learned from this case study include the fact that local community empowerment is at the heart of technology transfer effort. In this case, the workshops became the transfer vehicle. By using sound adult education pedagogies that respect the different ways adults acquire learning, the architects (CSIR) achieved their goal of sharing and transferring knowledge and learning.

### **8.3 Community-based labour-intensive construction of the Amadiba road**

The Amadiba community, which is nestled in the Mbizana Local Municipality, situated in the O R Tambo District in the Eastern Cape Province of South Africa, approached the CSIR through a local not-for-profit organisation for assistance to upgrade their road (Mashiri, 2004). Mbizana is considered to be one of the poorest local authorities in South Africa with upwards of eighty percent of the population living below the poverty line, and a significant number of households having no income at all. The CSIR secured close to US\$1.5m for the construction of the road which, except for vehicles with a high clearance such as tractors and “4x4s” vehicles, was generally impassable particularly in inclement weather.

Community-based labour-intensive construction of the Amadiba Road, which stretches for forty kilometres from a black-topped provincial road to the Mtentu estuary ended in October 2003. It is germane to note here that the balance of evidence suggests that the road has had a positive impact on the livelihoods of the Amadiba community.

The overall aim of the project was to enhance accessibility to socio-economic opportunities for the upwards of 15,000 people served by the road, including some 1,500 households located along the road. Specific contract objectives included:

- Development of sustainable road infrastructure to facilitate development and wealth creation for the Amadiba community
- Creation of jobs through road construction and maintenance work
- Development and strengthening of the local skills base as well as the transference of technology to community members involved in the project
- Arresting environmental degradation resulting from the proliferation of tracks created by motorists when designated roads/tracks are impassable
- Building the capacity of Mbizana local authority officials to monitor a project of this nature as well as to design and manage a road maintenance plan.

#### **8.4.1 Key success factors for technology transfer and adoption**

The Amadiba community-based labour-intensive road construction project can legitimately be considered as one of the more successful projects of its type. It is important to seek to understand the key success factors associated with technology transfer and adoption that could become the fulcrum for future implementation of similar projects:

- Community-based projects by definition depend on community engagement and support to sustain them. The community has to demonstrate that it needs this road infrastructure investment or new technology. In this case, the community, through a not-for-profit organisation approached the CSIR for assistance in upgrading their road. This meant that the community had vested interests in the success of the project rendering resource mobilization was relatively easy given their commitment and willingness to get involved in project design and implementation.
- Communities need a rallying point to enlist their continued cooperation as well as for them to approach any assignment with a singleness of purpose and commitment. In this regard, a premium was placed on getting both the approval and active support of traditional and political leaders in the Amadiba area, as well as some influential opinion leaders. Enlisting these community leaders increased the social acceptability of the project and enhanced its “value” to prospective participants from the community.

- Beneficiary communities are often not homogeneous, and sometimes have overt conflicting interests. It is thus often difficult to maintain the required level of community interest and support for projects over an extended period for successful completion. A social consultant, who is trusted, respected and perceived as an honest broker, should be an integral member of the project team. In this project, such a consultant was hired to mobilize and galvanize the community around the benefits of the project, as well as to explain and to iron out potential mine fields, such as the level of funding available, wage rate and payment policy, technology issues and project implementation modalities. This also had the effect of entrenching transparency in project management – an essential ingredient for pre-empting conflicts. The social consultant also sought to mobilize the community to actively influence the direction and execution of the project rather than merely seek to receive a share of project benefits. The project thus benefited from local knowledge systems, especially with regard to the alignment of the road.
- Governance issues in the management of community-based projects are critical to the success of candidate projects. The need for a legitimate, balanced and representative institutional framework underpinned by a consistent management structure, which is properly located in the overall scheme of things [for example, it could be located within the ambit of and relate to an integrated rural development framework], cannot be over-emphasized. In this case, for instance, a project steering committee consisting of all relevant stakeholders and with appropriate feedback mechanisms to both the local Integrated Development Plan and the Provincial Growth and Development Strategy, was able to navigate potential conflict areas such as negotiating acceptable wage rates [below minimum wage] with the community, selecting local candidates to constitute a construction management team, as well as developing a framework for recruiting labour. This platform allowed for continuous learning by incumbents, allowing sufficient flexibility and robustness in project implementation. Because of its legitimacy, the steering committee was also able to follow to the letter, the provisions of the Code of Good Practice for Special Public Works Programmes, including consistent job/task descriptions, which enhanced transparency and fair play in project management.
- To engender a substantial impact on the community during the life of the project, and sustaining that over a longer period, a significant amount of project funds need to remain within the community to feed local economic circuits with a view to enhancing project multiplier effects. It is also crucial to minimise leakage of project funds outside the community to maintain and eventually build a surplus on the village's balance of payments. The Amadiba road project demonstrates this truism relatively eloquently. For example, with the exception of the construction of low-level bridges, machinery [tools and small plant procured from outside the local municipality] was consciously used sparingly on the project to minimise leakage of project funds. In fact, the project team proactively sought to plug potential leakage areas, for instance, materials especially gravel and haulage services were sourced locally. As indicated elsewhere, because sixty percent of direct beneficiaries were women, project earnings were mostly employed in the community. In addition, by employing the CSIR as both the civil engineering consultant as well as the contractor, the project saved money that was redirected at employing more villagers. It is thus not surprising therefore that close to 70 percent of the project value of US\$1.5m was earned directly by the community, illustrating the spread of community benefits derived from the project.
- To ensure sustainability, it is also important to meaningfully involve the responsible local authority both in the administrative structures e.g. to serve

on the various project committees, as well as to expose it to operational aspects of the project at the coalface. Such a capacity building exercise is much more likely to ensure not only that the asset is maintained, but also that such investments could be successfully replicated. Such authorities would also be more likely to perceive the value of developing and nurturing the nascent construction enterprises created as part of the project, by providing them with an environment and opportunities to tender for manageable contracts, thereby building a cadre of skilled entrepreneurs to drive local economies. They would also be more attuned to the value of community involvement.

- Women-headed households are a common feature, particularly in rural areas (Mashiri & Mahapa, 2002), for many reasons, chief amongst which, is migration of men to greener pastures especially in urban areas. Given that women have a societal obligation to look after their families (*ibid*), they are less likely to migrate from their villages but are more likely to remain committed to these community-based projects. Building the capacity of women to be meaningfully involved in such projects guarantees sustainability particularly with regard to maintenance. Good practice examples abound in the project under review. For example, of the 1,700 villagers who were employed on the project, 60 percent were women. Although there were fewer women in management positions, clearly, there was demonstrated commitment to the empowerment of women. It is also of interest to note that the incomes that women earned on the project were largely employed to pay school fees, buy provisions and agricultural inputs from local shops, thereby reducing leakage of project funds out of the community. It is thus important not to ignore, underplay or misunderstand gender issues in community-based labour-intensive projects of this nature, but to seek to mainstream their involvement to enable them to make their full contribution as well as to receive their full share of project benefits.
- Payment policies can make or break a labour-based project, for example, delayed payments often stymie progress. On this project, wage payments were initially made into a commercial bank by special arrangement. Given the small amounts and the withdrawal patterns of poor households, the bank charged the account holders relatively significantly in relation to the wages. Thus, for most villagers on the project, the bank charges became unbearable, and they agitated for change involving direct payment to villagers on site. Although this was risky, it was nevertheless implemented, pointing not only to the robustness of the administrative structures, but also to the level of community involvement in project implementation. Given the risks associated with administering such a big paycheque in the open, points to the effectiveness of law enforcement efforts as a result of the improved transport environment.
- Labour-intensive productivity depends on adequate management. Organization of activities by the contractor must be properly planned and efficiently executed. On this project, the contractor in association with the construction management team managed the project effectively, including capacity building and training of project beneficiaries, thereby raising productivity substantially, as well as completing the project on time, budget and according to specifications.
- Given that most expenditure on infrastructure in South Africa, as is the case in other developing countries, is provided by government [national, provincial, local, and parastatal], government is essentially both a client and a customer. For such technology transfer projects to be successful, government needs to manifestly show undivided and indivisible commitment not only to the objectives of the incumbent project, but also to the overarching strategic aims

of poverty alleviation and growing of local economies. The government was equal to the task on these issues.

## 9. Concluding remarks

The strong link between economic prosperity, competitiveness and innovation is not surprising. The challenge though is to develop mechanisms to improve the capacity to innovate, and unleash the full capacity of science, engineering and technology for the betterment of all. To this end, technology development, transfer and adoption play a pivotal role in setting the conditions for innovation and higher productivity.

Clearly, the application of existing technical knowledge is very far from optimal largely because of endemic and often chronic institutional challenges covering an interrelated array of issues including a lack of finance, poor organization, inadequate regulation, capacity constraints, poor planning procedures, corruption, conflicts of interest, and inadequate stakeholder participation. There is therefore substantial scope for investigating the current constraints and how existing knowledge may be better implemented. Technology transfer centres are crucial in this regard.

Dissemination is an important element in implementing new research. Where the boundaries and structure of knowledge are well understood a well written research paper or guideline document could suffice, but where there are blurred boundaries, for example, relating to institutional reform, additional information may be required by way of engagement with the source of knowledge. In this regard, there is ample anecdotal evidence to strongly recommend the use of pilot and demonstration projects as a way to test, assess and validate the applicability of technologies on a wider scale. Central to these demonstrations would be the need to engage the services of the initiator of the technology to assist with the initial project design as well as shaping the project to ensure that impact evaluation can be undertaken. There is also ample evidence to suggest that tailoring the technology to the particular needs and conditions of the host area is just as critical as ensuring that the need for the technology emanates from the grassroots.

## 10. References

CHESS, C & K.Purcell, 1999. *Public participation & the environment: Do we know what works?* Environmental Science & Technology, Vol. 33, No.16, 1999.

GUERIN, T.F. 1999. *An Australian perspective on the constraints to the transfer & adoption of innovations in land management.* Environmental Conservation 26 (4): 289-304, Foundation for Environmental Conservation.

HINE, J.L. 2001. *Priorities for DFID's Knowledge & Research Transport Program*, Second Draft, DFID, United Kingdom

JACOBS, B. & D.L. Weimer 1986. *Introducing capacity building: The role of the external change agent.* Pp. 139-162 in: Perspectives on Management Capacity Building [B.W. Honadle & A.M. Howitt, eds.]. State University of New York Press.

KASH, D.E. 1989. *Perpetual Innovation: The New World of Innovation.* Basic Books, Inc., New York.

MARJOLIJN, J. C. Knot, Jan CM van den Ende, Philip J. Vergragt, 2001. *Flexibility strategies for sustainable technology development.* Technovation 21, ([www.elsevier.com/locate/technovation](http://www.elsevier.com/locate/technovation)), Pergamon.

MASHIRI, M.A.M & Mahapa, S.M. 2000. ***Social exclusion & rural transport: Gender aspects of a rural road improvement project in Tshitwe, Northern Province.*** In: *Balancing the Load*, [ed by Priyanthi Fernando & Gina Porter] Chapter 2, pp13-18: ZED Books, London

MASHIRI, M. 2004. ***Community-based labour-intensive construction of the Amadiba Road: Findings of an impact study.*** Proceedings: 8<sup>th</sup> Conference on Asphalt Pavements for Southern Africa [CAPSA 2004], 12-16 September 2004, Sun City, South Africa.

MPONDO, B., M. Mashiri, N. Morojele & N. Tati. 2004. ***Report on the training of local communities & various stakeholders on land use planning & management,*** European Union / South African Department of Environmental Affairs & Tourism, Pretoria.

NAUDE, A., M. Mashiri & A Nchabeleng 2005. ***“New roads are not enough”: Planning & delivering more integrated, intelligent & sustainable rural access systems.*** Proceedings: South African Transport Conference, Pretoria.

NCHRP, 1998. ***Putting research into practice: A synopsis of successful strategies & case histories.*** National Cooperative Highway Research Program (NCHRP). Research Results Digest 225. Transportation Research Board. National Research Council. Washington, DC, June 1998.

TRB, 1999. ***Managing technology transfer: A strategy for the Federal Highway Administration.*** Transportation Research Board (TRB), National Research Council, Special Report 256.