CREATING JOINT EFFICIENCIES
Web-enabled supply chain services for rural communities

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Abstract: Currently, about half the population of the world lives in rural areas, and they are disadvantaged regarding access to the basic technical knowledge to exploit the expanding Internet infrastructure. They lack readily available supportive tools, methodologies, and the capability to take advantage of the newly developed technologies to integrate their supply chains. This paper identifies the need for support environments in the development of web-enabled supply chain services for rural areas, based on the concept of a so-called design studio, which uses simulation models and collaboration technology to facilitate the design. The practical applicability of the concept in creating joint efficiencies is discussed before concluding that the conceptual model presented may provide a much-needed solution to some of the failures and problems faced when trying to put supply chains in rural areas onto the web. Exploratory cases are being carried out to prove and validate the applicability of the concept.

1 INTRODUCTION

Currently, about half the population of the world, particularly in the developing and transition countries, still lives in rural areas (UN, 2004). In comparison to urban areas, most of the rural areas are heavily underdeveloped and perpetually characterised by physical remoteness from basic amenities, poor infrastructure, fragmented and chaotic distribution systems, problems with cash flow, low supply chain volumes, long distances to markets, high unit transportation prices, and cases of multi-tiered middlemen, among other issues (UNCTAD, 2003). These conditions mean that there are currently very few efficient supply chains, and that although improvements may take time, there is still hope that things can be done better especially if carried out through the web.

However, rural people are disadvantaged regarding access to the basic technical knowledge to use the expanding Internet infrastructure effectively (Klein and Jang, 2003). They usually do not have readily available tools and methodologies to assist in effectively accessing or "organizing" new value-added or niche markets for their products. They lack the capability to take advantage of the newly developed technologies in ICT to participate in those supply chains that reduce their vulnerability to risk while increasing their direct profit. In many cases, *new* supply chains should be created that are geared to the specific situation in the rural areas, such as bad accessibility, lack of planning, and dependency on external influences such as weather.

Given this situation, there is need to create models to help illustrate, simplify and manage supply chain operations for rural areas (UNCTAD, 2003). One of the basic ideas is to use web-enabled technologies and portal technology (Boyson et al., 2004) to make the services accessible and easy to use from remote areas. The aim of this paper, following on (Janssen, 2001) is to show that the development of web-enabled supply chain services for rural areas using a support environment is more effective than when such services are developed without a support environment.

The paper highlights the need to provide support for coordinated development practices in the development and exploitation of web-enabled supply chain services, and outlines a practical set of interventions that can be deployed as part of the support environment. It provides an example model and concludes with a prognosis of the potential impacts of the solution in terms of the establishment of practices to create repeatable local solutions.

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1.1 Need for a support environment for web-enabled services development

The lack of supportive models to analyse decisions for creating web-enabled rural supply chains might be part of the reason for the low rates of technology absorption and chaotic situations that exist in attempts at improving rural supply chain operations.

Many rural areas possess large amounts of data that is both of local and national importance, and very little is done to provide the (rural) stakeholders shared access to it. The result of this is that the typical rural person does not have the capability to utilise the available information so as to realize the necessary efficiencies of industrialized agriculture (Klein and Jang, 2003). It is important that we design re-usable approaches for developing our service architectures, which can be easily modified by using a directly available and relevant approach, embodied in a support environment. Such an approach would ideally consist of methodologies that allow us to scale up or out as required by the pertinent situation.

A support environment (Sol, 1992) should enable decision makers to focus on the relevant design issues and treat context specific issues from various points of view. Decision-making (Keen and McDonald, 2000) is still too much viewed in terms of technology. Current theories, frameworks, and planning tools are incomplete and of limited use (Kambil and Short, 1994) in helping decision makers understand and manage the complexity of these emerging, interdependent, networked environments. Based on this, we therefore need to develop a support environment (Janssen, 2001) aimed at helping the stakeholders to identify opportunities and evaluate the business values of their decisions.

Indeed, rural areas have many assets arising from their peculiar environmental, social and institutional conditions, their position and valuable countryside features including natural habitats, scenic landscape and farming practices, limited infrastructure, etc. (Savoldelli and Innocenti, 2001) and in a way the use of the web is seen as being able to assist in overcoming some of the disadvantages of dispersion. Given that the main activity of rural areas is agriculture, it is assumed that web-enabled services could provide the means for improving the delivery of inputs, enhancing access to markets as well as enabling the interaction between farmers and agricultural institutions (UNCTAD, 2003).

The United Nations' General Agreement on Trade in Services (GATS) recognizes that web-enabled services in which service delivery is done across borders (UNCTAD, 1998) are eligible substitutes for other modes of service delivery, and we believe that supply chains fit into this category. The provision of support for the development of this mode of service is the focus of this paper, in which the phrase 'across borders' has been loosely extended to include borders within countries. However, access to telecommunication networks is a key issue for the development of web-enabled supply chain services, and access initiatives need to be stimulated.

1.2 Web-enabled Services

These are services made possible with the help of web-based technologies, mostly used when referring to services delivered over telecommunication networks or the Internet to a range of business areas and verticals (McGraw, 2001, MIT, 2003). The technology is used essentially as a tool or enabler to provide the services, in which most of the functions tend to be human-intensive and the processes and services may be outsourced in order to derive a cost advantage without sacrificing quality and efficiency.

Web-enabled services cover the entire range of services that exploit the web for empowering an organization with improved efficiency or types of services that may not be possible to be rendered cost effectively without the web. The web-enabled services (Glass, 2000) are built upon another level called web services, which is defined as a collection of functions that are packaged as a single entity and published to the network for use by other programs. Web services (Turban et al, 2004) expose or consume functions or content programmatically via the Internet and can be viewed as building blocks for distributed systems.

For rural areas (UNCTAD, 2003), exploitation of the web for provision of supply chain operations is highly desirable given that their commodity supply chains involve many intermediaries, with the result that the export earnings are shared by a multitude of traders and processors, and producers receive only a small share of the final consumer price. The concept of providing support for their development is particularly relevant for identifying areas in which potential bottlenecks may arise and designing commodity-specific support services. The support offered to the developers will be at a higher level above the basic functionality of the supply chain itself. Using some basic characteristics adopted from (Easton, 2003), the situation of a supply chain in a rural area is presented next, to set the pace for the discussion related to the development of a support environment.

2 A RURAL SUPPLY CHAIN

2.1 Characteristics and constraints

2.1.1 Geography

The interior parts offer the most significant development opportunities for web-enabled services given that large sections of the population live there. However, the challenges are higher due to poor access to the hinterland and the general lack of good infrastructure (Conyers, 1993, Easton, 2003, Smyre, 2000). The rural communities have to travel long distances and over generally rough terrain to get to the markets to sell their goods, which means that they carry less and therefore make less money due to the low volumes and high cost of shipment (Naude, 2004).

2.1.2 Infrastructure

In most rural areas, there is a general lack of proper road, rail, warehousing, and logistics capabilities. The most common method of transport for goods is by road, which also seems to be the most preferred (and cheap) option for moving goods to the market. In general, road transport is thought of as offering the most flexibility and control over delivery times and the delivered condition of goods. In most cases, the road transport network is not entirely well developed and consists of very few tarmacked or all weather roads, which are barely passable in times of heavy rain (Conyers, 1993, Smyre, 2000).

On one hand, small and privately owned vehicles dominate the road transport industry, and high amounts of empty miles and high unit transportation costs are a common characteristic. Given the low level of infrastructure development and low incomes, there is very little use of containerisation and inter-modal operations. On the other hand, coupled therewith are the high trucking costs and relatively low security of goods in transit (Easton, 2003).

2.1.3 Production

In many cases, the rains come at specific times of the year, which directly translate into planting times for the farmers, who in turn tend to grow the same kind of crops determined by the area their farms are located in. Given that the weather patterns generally remain the same for the same area, it means that everything that goes into production of the farm produce is done at the same time by all the farmers e.g. planting, spraying, weeding, harvesting, etc. As a result, all of them harvest their produce at the same time and because storage facilities are not well developed most of them have to sell their goods immediately after harvest. This means that they cannot bargain for better prices, and that they cannot defer their selling so as to wait for when the market is at its best (Naude, 2004).

2.1.4 Periodic markets

Closely related to production (Naude, 2004) is the fact that there is limited direct access to markets that are slightly further than the nearest shopping centre (e.g. urban or international markets). Many rural areas have a model of periodic markets, which are held in some focal points, mostly close to major road networks and trade centres that act as feeders for the urban areas. Given that a lot of the produce comes from far-flung rural areas, it is desirable to coordinate the service provision and schedules for the periodic transportation of the goods and the farmers to and from the markets. There is also need to provide facilitation for freight collection and distribution services and subsidisation in support of the coordinated schedules, centres, and services. Coordination of local transport to coincide with local periodic markets, mobile clinics, school transport, etc. is also desired (Naude, 2004).

In some cases, you also have brokers and middlemen who supposedly take the burden of going to the far-flung periodic markets from the farmers. They provide transport services as well as collection points at which they buy the produce, but these multi-tiered middlemen make the supply chain too long and therefore unproductive (UNCTAD, 2003).

2.1.5 Telecommunications and the Internet

In most rural areas, teledensity remains depressingly low (Parkes, 2001), though the mobile services market is growing rapidly. Mobile penetration rates in rural areas are very encouraging, with most people having access to the mobile networks, and this may provide some of the needed stimulus for accessing web-enabled services.

Internet connectivity still remains dramatically skewed in favour of urban areas, though some efforts have been made to provide local access points in some of the focal areas of rural regions. The International Telecommunications Union (ITU, 2004) notes that given the rising demand for Internet access, wireless technologies could provide the solution for rural areas.

However, very little use is currently made of the available telecommunication infrastructure for the purposes of improving the supply chains.

2.2 Utilisation of the opportunities

Based on the existing situation presented earlier, it becomes clear that some of the problems facing the rural communities can be solved by introduction of web-enabled supply chain services. As a result, it is important to provide support for the development of such services to integrate, centralize, and rationalize supply chain functions, assets, infrastructure, people and operations. Encouraging free flow of information, use of supply chain technologies, provision of one-stop solutions, and end-to-end synchronisation of logistics services, all via the web, can be used to do this.

The general deduction that can be drawn is that the technology and access to it from the rural areas (UNCTAD, 2003) is no longer the main problem, and therefore there is need to strengthen and improve the development practises to enable services to be efficiently provided over the web i.e. delivered remotely. However, some of the underlying problems are caused by farmers' lack of access to market information and their resulting inability to bargain effectively. The development of commodity market information systems and the use of the Internet by producers themselves can enhance market intelligence to the benefit of agricultural producers (UNCTAD, 2003).

A support environment for the development of web-enabled services is expected to provide the much-needed support to the already existing initiatives, as well as to stimulate the uptake of new technologies. Use of the environment would then allow the developers to model and simulate the development processes and accessibility of the rural communities to both national and international markets for their goods and supply chain services.

It is the assumption of this paper that if the design and development processes for web-enabled services were standardised to incorporate best practices exhibiting some means of repeatability, it would be easier to expand the functionality of the services provided to the rural communities. A model incorporating possibilities of providing location-based services or services offered over mobile devices is highly desirable, given that it has been proven (ITU, 2004) that it is possible to provide services via mobile phones and networks, thereby by-passing the ever present discussion about lack of telecommunications infrastructure in rural areas.

Also worth taking advantage of is the presence of cyber-cafes in many of the focal centres of the rural areas, which has meant that provision of services is no longer a mirage. If the cyber-culture were to be encouraged to grow further, it is expected that it will create some critical mass that utilizes the services provided, thereby assisting in lowering the charges associated with providing the service. With web-enabled services, we get the advantage of ubiquitous access, fast assembly of components, and optimum utilization of existing resources as these can all be done in a distributed manner.

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Given the characteristics explained earlier about rural areas, it becomes imperative that we are able to create a link between several of the services provided to the rural communities to effectively utilize them. Through the use of the web, we can provide for coordination of transport in rural areas so as to reduce the amount of empty miles traveled by ensuring that trucks can offer services mid-way. Especially since the distances traveled are very long, it would also be desirable if the farmers could be able to book for transport services in advance to coincide with, for example, the periodic markets.

The use of web-enabled supply chains in the rural areas can reduce transaction costs in a number of ways. The first is the reduction of search costs, because buyers and sellers can easily locate each other without necessarily traveling long distances (UNCTAD, 2004). Multiple intermediaries characterize rural marketing chains, and buyers spend much time searching for information about suppliers, products and prices. Web-enabled services may reduce search costs in terms of effort, time and money, because information can be exchanged more efficiently via the web than through traditional channels. Use of web-enabled supply chains can also increase the efficiency of existing intermediaries to the extent that they adopt the new information technologies. This may lead to the development of e-markets, which can be viewed as new intermediaries to replace traditional offline intermediaries.

Another area in which the joint supply chain efficiencies can be utilized is in the coordination of non-emergency mobile services that can be done in such a way that one takes advantage of the other. For example, in many rural areas there are mobile health clinics, banking services, and periodic markets. Having a system that supports brokering of transport in such a way as it fully utilizes the available capacity would be very beneficial to the rural communities. To complement this, organized agricultural bodies (e.g. cooperatives) can be used to improve the logistics services, and coordinate the periodic markets.

3.1 The Conceptual Model

We feel that the development of web-enabled services can be done better if the developers were provided with a support environment that gives insight into the complexity and dynamics of the supply chain, while supporting and simplifying the design process. Access to the services, the providers, and the data can be done via web-enabled connections, which in this case are taken to include peer-to-peer networks. This concept is presented in figure 1.

The service development environment presented in figure 1 builds on the idea of (Keen and Sol, 2005), and begins from the decision process and works back to the system providing a front end tool that enables developers of web-enabled services to work with the existing data rather than the other way round. An approach within the environment is used to support the entire process of developing web-enabled supply chain or other matching services, which will most likely have multiple stakeholders with varying needs.

3.2 The Support Environment

The support environment, referred to as a **studio** by (Keen and Sol, 2005), is interactive and it is where **suites** are deployed. The suites are toolkits for the designer, selected on the basis that they are the most effective resources for support in the particular decision domain. The effectiveness of the studio rests on its processes, which fundamentally involve people and collaboration. The studio contains domain specific processes for effective decision enhancement practice known as **recipes**, which are proven, repeatable, sequential, and used. Within the environment provided by the studio, the decision makers are in a position to make more informed, enhanced, and repeatable choices. Figure 2 (Keen and Sol, 2005) diagrammatically presents the idea of a framework for the decision enhanced studio.

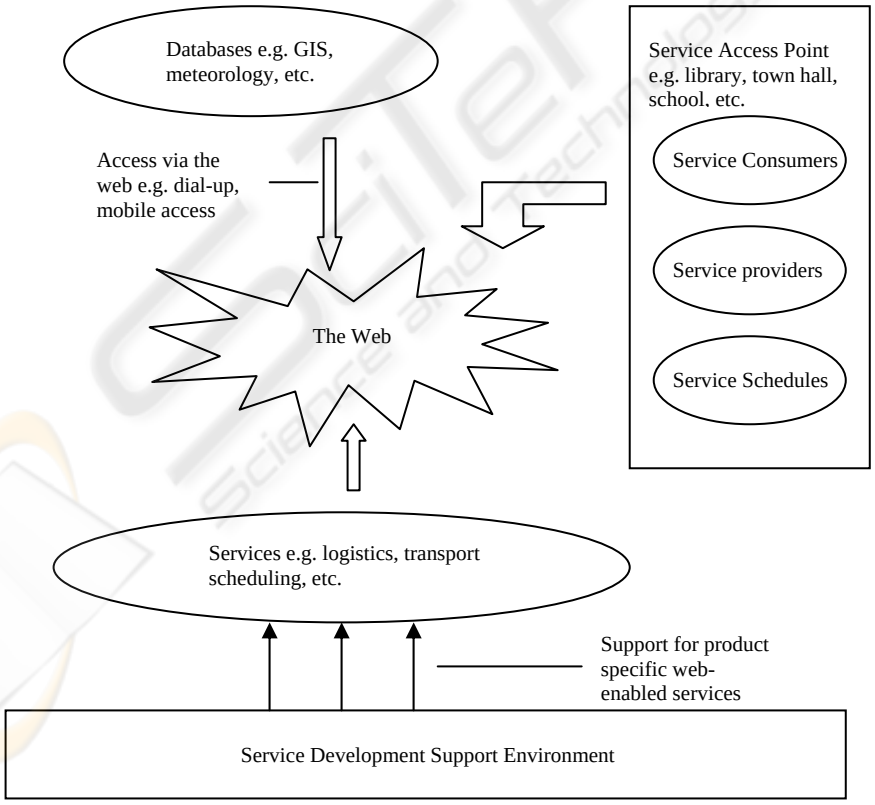

Figure 1: The service development, support, provision, and consumption environment.

The studio is centred on the design of skilful, flexible, focused activities at the level of the workplace, the organization, and between organizations. It helps decision makers visualize scenarios and alternatives, thereby giving them the chance to 'rehearse the future' by framing decision making situations, providing facilitative services, and applying proven and adaptive recipes in specified contexts. The development of activities takes place in studios, which are targeted at decisions that matter. The studios make use of services that can support or improve the decision making process by increasing the decision process agility, referred to as Decision Enhancement Services (DES). Some of these services include:

- Services that shape the environment in which we participate with other actors: *landscaping*
- Services for collaboration and participation that need to be *facilitated* separately
- Services in the form of examples, scenarios, *recipes*
- Services for designing the processes, to achieve real *Business Process Agility*
- Services as *instruments* in the sphere of animation, visualisation, (gaming) simulation
- Services that develop and realise effective cooperation, *collaboration*, within the studio

These services of a studio make it a very attractive option for the design of a support environment in which the development of web-enabled supply chain services for the rural areas can take place. The decision makers and other stakeholders are provided with the opportunity of gauging their initiatives before implementation, and this is expected to greatly improve the outcomes of the various web-enablement initiatives.

3.3 Applicability of the concept

As is typical with any service implementation, the service providers are often faced with almost immediate requirements to change their structures or add new structures to their profiles to suit customer needs as soon as their product is ready. Such additions or modifications may require re-designing several tiers of the existing service environment. In such a scenario, it would be more efficient if we did not have to re-build the service architectures every time but instead just modify the relevant structures using a readily available approach. This approach containing the various structures would be included in a studio, thereby making it a useful solution. Because of the fact that dynamic models and visualization of ideas play an important role in the concept of a studio, it supports both the gaining of qualitative insight for all stakeholders into the potential solutions, and quantitative results when comparing alternatives.

To illustrate this, an example application taken from the realm of rural logistics where web-enabled services could be particularly relevant is when there is need to coordinate periodic transport, service provision and market schedules. Based on the characteristics presented earlier, this would include important aspects such as routes, stopping places, and service times, considering that each of these can vary even for the same customer group.

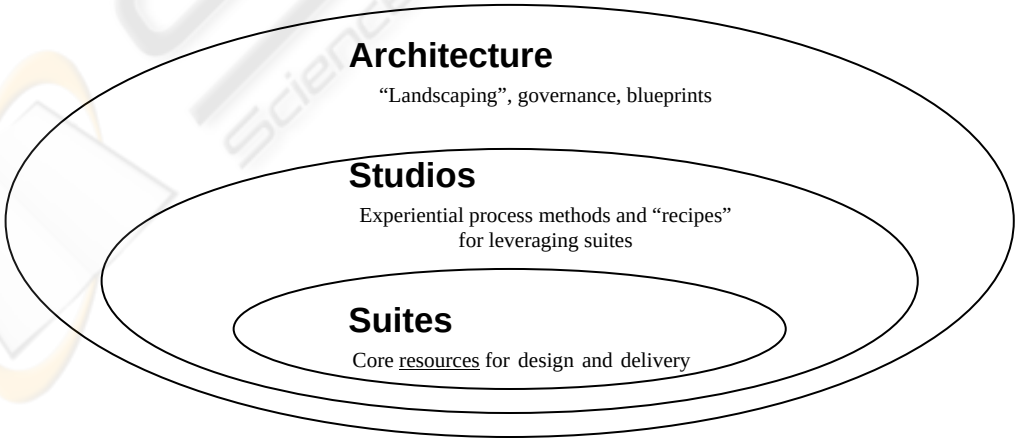

Figure 2: The Decision Enhanced Services Framework

In such a case, it would be useful to establish a system for arranging and disseminating information about meetings and/or service access points and times that might involve a different combination of services and customer groups (Naude and Mashiri, 2000). By implication, mobile technology may have a key role to play here in accessing the web-enabled service. Using the studio, the developers would then be able to model, simulate, and toy around with the possible decision scenarios that can be taken to get to the optimum decision.

In other cases, there may be a need to focus on how different service supply chains involving information and physical flows, as well as durable and 'rapidly vanishing' stock could usefully link with other service supply chains to create joint efficiencies and add value to the supply chains. Again, in this case, rehearsing the different scenarios within the studio would provide very helpful insight before implementing the service, and simulation model results could easily demonstrate the potential benefits to all involved stakeholders.

Owing to the peculiar situation of their environment, most communities living in rural areas regularly need to have access to logistics, transportation, education, and many other services which can be better provided through the use of web-enabled technology. Use of the studio would provide an environment to support the development of these services. The services would then be accessed via the local point of access to Internet in the community, which would often be the town hall, library, local school, or a cyber café in a rural centre.

4 CONCLUSIONS AND FURTHER WORK

The paper has attempted to show how the development of web-enabled supply chains for rural areas using a support environment can be more effective than when you develop the services without a support environment. The conceptual model presented may provide support for a much-needed solution to some of the failures and problems faced when trying to put supply chains in rural areas onto the web.

Web-enabled technologies are continuously becoming essential tools in the development and management of rural supply chains, since they provide enhanced market access for rural communities and for organizing markets and supply chains. Considering that some of the (often GIS) data is already present, several institutions and government bodies would then only worry about developing relevant business models and technical solutions to implement new services for rural communities. Using these databases in combination with other local variables, it will then be possible to create joint efficiencies in the rural areas by utilizing every available capacity effectively.

The concept presented in this paper and the accompanying discussions are part of work in progress, and exploratory cases are being carried out to prove and validate its applicability.

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