Information Systems Development in Nigerian Software Companies: Research Methodology and Assessment from the Healthcare Sector's Perspective

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ABSTRACT

The requirements for software and information systems for healthcare institutions in Africa differ from those in the industrialised countries in many ways. Local software development, adaptation and organisational implementation is thus highly important. However, very little empirical research has been conducted on the work practice of software engineers and information systems developers in developing countries. In this paper we discuss the methodology for studying the practice of information systems development (ISD) in Nigerian software companies from the healthcare sector's perspective. We argue that such a study must be divided into two parts, one aiming at a "landscape view" using a survey, and the other at "in-depth portraits" using case studies in different companies. An Activity-Theoretical research framework is introduced for the latter. The emphasis of the paper is on the theoretical framework and the research methodology, which are proposed for other researchers with similar objectives. However, some main results of the on-going study in Nigeria are also presented. Finally we discuss first Nigerian software industry's capability to respond to the needs of the country's healthcare institutions, and then the applicability of the proposed research methodology to other contexts.

Keywords: Software industry; information systems development; healthcare requirements; developing countries; research methodologies; Nigeria

1. Introduction

International development agencies have begun to regard Information Technology (IT) as one of the key ingredients in accelerating socio-economic development and in narrowing the gap between Africa and the industrialised countries. If the potential of the "African Information Society" is to be realised, IT should be used to enhance the effectiveness and efficiency of the highest-priority sectors for socio-economic development, for instance healthcare, by introducing appropriate information systems.

However, appropriate software packages for African hospitals and health centres cannot be found off the shelf – the requirements are too different for an African hospital to be able to benefit from an American or European hospital application without major adjustment, and the situation is even more problematic in primary healthcare. Appropriate software packages and organisational information systems for African settings must thus be developed locally, even if a foreign package can be used as a starting point for adaptation (cf. Heeks, 1999). To be properly equipped to provide their clients with appropriate information systems, systems developers in any country and organisational setting need Information Systems Development (ISD) methods and education that are adjusted to fit the socio-economic, organisational and technological context in question (Avgerou, 1996; Waema, 1996; Walsham, 2000).

A distinction must be made between a software product (application package) and an information system (IS). The latter refers to the information processing activities in an organisation which may or may not be facilitated by modern information technology – i.e., an IS is a *social* system including some technological elements, *IT in use*. A respective distinction must be made between Software Engineering (SE), which deals with the *technical construction* of software products, and ISD, which deals with how to *serve organisational purposes* by means of software products and other forms of computer-based and manual information technologies (Korpela *et al.*, 2000 a). It can be assumed that SE is more similar across countries, while ISD is dealing with social issues and thus varies more according to the socio-economic and political setting in question (Mursu *et al.*, 2000).

Very little empirical research has been conducted on the work practice of software engineers and information systems developers in developing countries. It is unknown what kind of formal and informal methods they apply, what are the main problems they face, and whether the training and methods they have at their disposal are appropriate for their special requirements. More generally, there is not much empirical evidence on whether information systems development is very similar or widely different in industrialised and developing countries. If there is a significant difference, then it is obvious that "universal" ISD methods and education must also be significantly adjusted to fit the special requirements of the socio-economic, political and cultural setting in a given country.

In this paper we discuss the methodology for studying the practice of information systems development (ISD) in Nigerian software companies from the healthcare sector's perspective. The objective is to assess Nigerian software industry's sustained capability to produce the kind of computer-supported information systems that the country's healthcare institutions need. The emphasis of the current paper is on the theoretical framework and the research methodology, while the empirical findings will be published in a series of other papers.

The structure of the paper is as follows. The wider research project is described in section 2. The specific research object for this paper is defined in section 3. A "landscape view" methodology for studying the research object is presented in section 4 and an "in-depth portray" methodology in section 5, both of them illustrated by some empirical results. The paper ends with a methodological discussion and conclusions.

2. THE WIDER RESEARCH SETTING, OBJECTIVES, AND DESIGN

The INDEHELA–Methods project (Methods for Informatics Development for Health in Africa) by the Department of Computer Science and Engineering of the Obafemi Awolowo University (OAU), Nigeria, and the Computing Centre of the University of Kuopio, Finland, was established to develop in 1998–2001 a "Made-in-Nigeria" ISD methodology which addresses the special needs of Nigerian systems developers. Healthcare is used as the main field of application in practical experiments and examples.

The core research group consists of a part-time senior researcher (overall project leader) and a full-time researcher (PhD student) in Finland, and a part-time researcher (local project leader, PhD student) in Nigeria. In Nigeria, another part-time researcher (MPhil student) and a couple of final year BSc students have participated in the methodological research at various stages. The local project leader in Nigeria is also coordinating a closely related practical systems development project, MINPHIS (Made-in-Nigeria Primary Healthcare and Hospital Information System), by the OAU Computer Science Department and the OAU Teaching Hospitals Complex. A number of other staff and final year students participate in the MINPHIS project.

The rough analytical framework of the project as a whole is presented in Figure 1. It deals with an entire service chain of activities (round shapes in the figure), embedded in a series of organisations (boxes), from university education through development and use to the citizens and communities that should ultimately benefit from IT. Correspondingly, several research questions are studied within the project. In the current paper the focus is on an overview of the software companies in Nigeria and the IS methods they apply, from the viewpoint of potential customers in the healthcare sector.

The main objectives of the INDEHELA-Methods project are, firstly, to *produce empirical information and understanding of the practice and problems of ISD in Nigeria*, and secondly, to *facilitate Nigerian ISD practitioners by improved methods, techniques, practices and education*, according to their needs and so that the society in large will benefit. In this paper we focus on the first objective.

Since there is no prior empirical research on how ISD is practised in Nigeria and what are the problems perceived by the practitioners, the study must proceed from an interpretative, knowledge-building research approach to a constructive one (Orlikowski and Baroudi, 1991; Järvinen, 1999). Correspondingly, the research design has three inputs followed by a constructive phase and dissemination of results (Figure 2; Korpela *et al.*, 2000 b):

(1) We started by identifying, through **theoretical analysis**, areas where the requirements for and constraints of ISD in Nigeria and in Africa in general may differ significantly from those of the industrialised countries (Korpela *et al.*, 2000 b; Mursu *et al.*, 2000). The purpose of this part is to direct the empirical research into issues that appear to be the

most relevant ones. Theoretical analysis was also needed to establish the research framework of the study (Korpela *et al.*, 2000 a; 2001 b; 2001 c).

(2) Relevant ISD methods, techniques and practices developed in other countries were identified through a **literature review** (Korpela *et al.*, 2000 b). In addition to ISD, related other fields – for instance, work research, organisational studies, primary healthcare projects, international development projects, etc. – were also investigated in search for relevant methods. Empirical studies on ISD practice in other countries were sought, to acquire guidance concerning the research methodology. However, such studies are regrettably rare even in industrialised countries (Russo, 2000; for a major exception, see Kensing *et al.*, 1998). The purpose of this part of the study is to provide "raw material" for adjusted methods and techniques.

(3) The main starting point of the methodological development must be an understanding of the existing practice and problems in ISD in Nigeria, achieved through **empirical research**. We started by an interview study focusing narrowly on risk factors in software development projects (Mursu *et al.*, 1999). We then enlarged the scope of the empirical research into information systems development in a wider sense, which is introduced in this paper.

(4) The three inputs are merged together to an adapted methodology, a portfolio of methods and techniques (Soriyan *et al.*, 1999). Currently the methodology is just a "prototype" which must be tested and further developed through **action research** (Avison *et al.*, 1999) in one or two real life "host projects". Two exploratory action research experiments have been conducted using the MINPHIS project as the host setting (Korpela *et al.*, 1998; Korpela *et al.*, 2000 a). The methodology will also be tested in Systems Analysis courses and final year projects of Computer Science students in the Obafemi Awolowo University. Later on the methodology should be tested in a software company by systems practitioners, and further developed again according to the feedback received.

(5) As soon as preliminary results are achieved in terms of increased understanding of the nature of ISD in Nigeria and adjusted methods to facilitate it, the results should be **disseminated** to practitioners through educational activities. The practical objective of the project is to produce a draft textbook for IS education in Nigerian and maybe other African universities – *Lecture Notes on Information Systems Development in Africa*.

Obviously, parts 1-3 must be re-visited from time to time during the research process. The research process is thus very similar to an iterative, prototyping ISD process, with the exception that the role of designers is now played by researchers, the role of users by practitioners, and the product is a methodology instead of an information system.

3. THE RESEARCH METHODOLOGY ON THE CURRENT PRACTICE IN SOFTWARE COMPANIES

Let us now return to the issue of how healthcare institutions in Africa can get computer-based information systems that meet the local requirements. The abstract service chain of Figure 1 can have different forms in practice, as depicted by four alternative routes in Figure 3. In each case, software is introduced into a healthcare organisation through ISD, but the origins and nature of the software and the activities and organisations involved differ. The alternative routes are the following.

(1) A pre-existing, foreign healthcare software package is imported by a local software company and adapted to fit the local environment and the customer-specific requirements.

(2) A healthcare software package has been developed locally by a software company, and is then adapted to fit each specific customer's requirements.

(3) A software company develops tailor-made software applications for a given customer, possibly as a pilot case for later package development.

(4) Tailor-made software applications are developed by in-house IT/IS experts, without a software company.

In Nigeria, the OAU Teaching Hospitals Complex acquired a rudimentary hospital information system in 1989–91 through a joint project in which the OAU Dept. of Computer Science and Engineering acted much like an in-house support department on route 4 (Daini *et al.*, 1992; Makanjuola *et al.*, 1995). The MINPHIS project is now upgrading and expanding that system into a packaged product. Another teaching hospital tried unsuccessfully to acquire a foreign package along route 1, and is now developing a tailor-made system with a small indigenous company along route 3. As far as we know, there are no other clinically oriented software applications in use in Nigeria, although private hospitals use computers for more mundane operations. More clinical information will certainly be added to such billing-oriented systems in the future, however.

It is thus impossible to study the current ISD practice directly in the healthcare sector. However, computers are used widely in some other sectors. Therefore we need to study how software companies operate in other sectors, try to identify cases along routes 1–3, and analyse if the procedures used are applicable to the healthcare sector also.

More than 200 registered companies offered computer-related services in Nigeria in 1988 (UNIDO, 1989) and more than 500 in 1994 (Alabi, 1994). By the turn of the century, the number of companies was by extrapolation at least one thousand, maybe up to 1500. However, most of them concentrate on hardware sales, training courses, etc. We estimate that probably no more than ten percent of the companies, i.e.100–150, develop their own software or provide information systems services.

A subset of 11 software companies in Lagos was initially selected for a survey, representing big and small companies, indigenous and foreign-owned, producing packaged software and tailor-made systems. The companies were selected from the members of the Computer Association of Nigeria by the Nigerian researchers in the project. Semi-structured interviews were conducted in November 1998 and March 1999 with 39 project managers or comparable persons. These interviews had an emphasis on the perceived risk factors in software projects. However, it soon became apparent that a software development project was too narrow a scope for the study (Mursu *et al.* 1999). Moreover, the questions we used for gathering information about the companies, projects and methods were too open-ended for statistical analysis, but too general for achieving a truly rich picture of the everyday practice.

The initial exercise showed that a study on the software practice in a previously unstudied country must be divided into two parts. An overall view can be achieved through **interview surveys** among a representative sample of the software companies. Quantitative

methods like surveys, however, cannot be used for generating deeper understanding or a rich picture of the issues at hand (Orlikowski and Baroudi, 1991). The overall view must be supplemented by descriptive **in-depth case studies** in a few companies and projects (Walsham, 1995). The next two sections describe the two parts, illustrated by some main results.

4. METHODOLOGY FOR A "LANDSCAPE VIEW": SURVEYS

A broader structured and guided questionnaire form for interviews was designed in November 1999 to capture basic data of a wider range of companies in a quantifiable format. The purpose of this basic questionnaire is to provide a "landscape view" of the main features of software industry in Nigeria. The questionnaire contained 45 questions divided into six parts titled "Company or institution", "IT personnel", "Female IT personnel", "Clients/customers", "Software products and services", and "Systems development work and projects". Most questions were of the multiple-choice type, so that the questionnaire could be filled in less than 30 minutes by one senior representative per company, and the combined results – the profile of the industry – could be presented in a simple graphic form.

The questionnaire was administered in February 2000 in a pilot set of nine companies known through the risk factor study. The pilot survey showed that the questions were comprehensible to the respondents and the form could be filled in a reasonable time. The same questionnaire was then administered in May 2000 in as many member companies of the Computer Association of Nigeria as could be approached, given the logistic and resource constraints. Each company was physically visited by the researchers or briefly trained Computer Science students, since prior experience had shown that mailed or e-mailed questionnaires resulted in a very poor response rate. Another round of interviews was organised in spring 2001, especially among companies that are not present in Lagos, the main commercial metropolis in the country.

In this paper we present only a few figures from the preliminary results of the spring 2000 sample, to provide a rough idea of "what a typical Nigerian software company looks like". The full results of the overview questionnaire, the results of the Delphi study on risk factors in software projects, as well as detailed reports on the case studies will be published separately.

Table 1: The "industry profile" of software companies in Nigeria (n=33).

When was the company **established**?	No reply	Before 1980	1980–84	1985–89	1990–94	1995–99	2000–
	1	2	2	10	12	6	
What is the **type of ownership** of (the majority of) the company?	No reply	Foreign owned (private sector)	Nigerian owned (private sector)	Government owned institution (parastatal)	Educational or research institution (public sector)	Government administration (public sector)	
	-	3	30	0	0	0	
How many **IT professionals** does the company have, approximately?	No reply	None	1–5	6–15	16–50	51–100	More than 100
	-	0	8	12	10	3	0
What is the **percentage of women** among the IT personnel, approximately?	No reply	None	1–20 %	21–40 %	41–60 %	61–80 %	81–100 %
	3	4	19	6	1	0	0
What size of companies are the **customers**, in terms of how many **employees** do typical customers have, approximately?	No reply	1–10	11–50	51–250	251–5000	More than 5000	
	5	1	5	16	15	3	
What is the main **type of applications software** provided?	No reply	Imported applications packages installed as such to the customers	Imported applications packages locally adjusted to local requirements	Self-made applications packages installed as such to the customers	Self-made applications packages adjusted to each customer's requirements	Applications tailored to the specific requirements of each customer	
	2	18	12	10	18	18	
What is the typical duration of a '**project**'?	No reply	A couple of months or less	Around half a year	Around one year	A couple of years	Several years or indefinite	
	4	16	12	11	3	3	
How many IT professionals are typically involved in a 'project'?	No reply	1 person	2–5 persons	6–10 persons	More than 10 persons		
	3	0	21	4	6		

The sample size of the survey in this paper is **33 companies**, which is fairly representative of the estimated number of 100–150 software companies. 91 % of the companies were Nigerian owned. Somewhat surprisingly, 78 % of the companies were **established** before 1995 (36 % in the period 1990–94 and 30 % in 1985–89). Every third

company (36 %) had 6–15 **IT professionals** and 30 % of them 16–50 IT professionals among their staff, while only 9 % employed more than 50 professionals. Most companies (79 %) had some **female** IT professionals among their IT staff, but only a minority (21 %) had more than 20 % of women and only one company reported a roughly even balance between men and women.

The average number of **customer companies** per software company was about 40, varying from 2 to 250. Every third company (33 %) had at least one customer outside of Nigeria, the average number of foreign customers being 4. Typical customer companies belonged into the categories of medium-size (51–250 employees) and large (251–5000 employees) enterprises, while only 15 % of the software companies had small-size enterprises (11–50 employees) and 6 % very large size enterprises (over 5000 employees) among their customers.

Regarding the **products**, the majority (55 %) of the companies provided 'self-made applications packages adjusted to each customer's requirements', the same number provided 'applications tailored to the specific requirements of each customer', and the same 55 % provided 'imported applications packages installed as such to the customers'. The least favoured product category was 'self-made applications packages adjusted to each customer's requirements', provided by 30 % of the companies. Typically each company had a significant proportion of activities in more than one category. More detailed factor analysis is needed to group the companies into import-oriented and tailoring-oriented segments.

Almost one half (48 %) of the companies had **projects** that lasted for 'a couple of months or less', the next most popular project duration being 'around half a year' (36 %). By far the most common number of IT professionals involved in a project was 2–5 (in 64 % of the companies), while only 18 % had projects which involved more than 10 professionals.

5. METHODOLOGY FOR AN "IN-DEPTH PORTRAIT": CASE STUDIES

Since the surveys provide only a broad outline of the industry, a different methodology is needed to get a "rich picture". We complemented the surveys by "in-depth portraits" of past projects in three different software companies. Contacts with the companies were established in March 1999, and in-depth interviews conducted in November 1999. A second round of interviews was conducted in November to April 2000.

5.1 The analytical framework

The ISD projects in the cases were analysed using a research framework based on Activity Theory. The roots and theoretical aspects of the framework have been published in detail elsewhere (Korpela *et al.*, 2000a; 2001b; 2001c). Figure 4 illustrates the elements of a work activity according to the framework. In short, a collective work activity (e.g., patient care in a health centre) consists of the actions of a number of individual *actors* (a physician, a nurse, a community health assistant, a medical records officer), which are directed to transform a shared *object* of work (a health problem) into a joint *outcome* (health). The actors influence on the transformation *process* through material and immaterial *means of work* (medical knowledge, drugs, health education material, health records). The actions of the individual actors, which do not necessarily take place simultaneously and in the same place, are linked together by *means of coordination and communication* (division of labour, rules, discussions,

health records) into the *collective actor* (healthcare team). The overall way of doing or spirit of the activity can be characterized as the *mode of operation* (e.g., hierarchical, team-oriented, fragmented).

The scope of the analysis can be enlarged from the inner structure and process of a work activity by studying who uses the outcomes of the activity being studied, and for what kind of an activity. In Figure 4, patient care serves the daily life of the local community by better health, but it also "produces" the object for secondary care by referring problematic cases to the local hospital. Likewise, we can analyse who "produces" and in what kind of activities the means, objects, actors, rules, etc. required in the activity being studied. Figure 4 presents only one such producing or supporting relation by identifying that the records needed in patient care are produced by a records-keeping activity. Moving our focus to the medical records activity (Figure 5), we can apply the same analytical framework again and analyse the object (patient care events), outcome (information about patient care), etc. of medical records-keeping. Figures 4 and 5 also depict the formal organisations, the boundaries of which split the networks of activities.

One further step is needed to bring the analytical framework to the real practice of ISD. If the management of the health centre in Figure 5 decided that a computer-based system is needed to facilitate their medical records activity, what kind of an activity should emerge and in what kind of an organisational setting? Figure 6 outlines the elements of such a project activity to develop a computer-based information system for a primary healthcare centre. It is a boundary-crossing, temporary activity between a software organisation and the customer organisation, drawing actors, means, rules, etc. from both sides.

We have intentionally used a healthcare example in this paper to illustrate the analytical framework. In the actual case studies, we used a couple of similar illustrated diagrams of different imaginary projects in a commercial setting to explain the interviewees what kind of information we are interested in. One diagram dealt with a typical customisation project based on a pre-existing locally made package, while another one described a first-time development project dealing with a new business sector and new technology.

When starting an empirical case study in a Nigerian software company, we narrate a short story of the illustrated imaginary cases and then start to ask questions like: *When your company last time had this type of a low-risk customisation project, which people were included in the project? How did you organise the project, what kind of planning and monitoring techniques did you apply? What kind of phases or stages did you experience between the project establishment and its completion? What kind of skills and development tools did people have at their disposal? From where did they get the skills and tools? What kind of interaction there was between your own staff and the customers, and did you experience any problems in understanding each other?* And so on.

The illustrated cases are used as inspiration only, not studied in detail. During the interviews we use a checklist based on the theoretical framework (Korpela, 1999) to ensure that all relevant issues are covered, but the checklist guides the flow of the interview only loosely. The checklist is used for identifying the networks of supporting and supported activities as well. Besides the activities, it is useful to identify which organisational boundaries exist between them.

In the rest of this section we present very brief "portraits" of three different real-life

projects – in a major foreign-owned company, a mixed-ownership company that has produced a software package of its own, and a small indigenous company producing tailor-made systems. The cases match roughly with routes 1, 2 and 3 presented in Figure 3, respectively. The real names of the companies are withheld, to safeguard the confidential relations with them.

5.2 Case study 1: A major foreign-owned company localising imported software

Alpha Corporation was established in 1982 to sell hardware and develop software. After some time they realised that suitable packages to solve customers' needs already exist abroad. Currently the company has about 120 employees and concentrates on identifying "good products" abroad and customising them for local needs. We interviewed two of their project managers about two specific projects, one for a manufacturing customer and the other for a bank.

In both projects the software product was a well-known modular package developed in Europe some years ago for global markets. Both packages run on Unix and a relational database with Windows front-ends. The manufacturing package is developed with a Rapid Application Development tool (Progress), but the front-end part of the banking software had to be re-developed in Java because of the customer's requirement.

The manufacturing project started in early 1996 and lasted for three years, while the banking project started in June 1998 and was completed in October 1999. In both projects there were separate but partly overlapping teams for project implementation and technical implementation, lead by a senior person from the customer side and by an experienced technical person from Alpha Corporation, respectively. The overall project leader was from the customer side. The projects were guided by a project plan, and progress was monitored in technical team meetings weekly and in steering group meetings monthly. Project planning tools were used but flexibly. Progress was reported regularly on several levels of the project organisation.

The technical team of the banking project included 14 people (three women) in three sub-teams. The manufacturing project included a varying number of people at different phases; two persons at the final implementation phase. All technical staff are Nigerian with a Bachelor's degree from a Nigerian university, usually in Computer Science. Experience in the business domain in question is also appreciated. The employees tend to be young (25–40 years), mainly men, often unmarried, because of the flexible working hours. The company organises periodic in-house training for the staff.

The projects started by studying the existing package and developing the specifications of the modifications and extensions required by the customer. Informal methods were used for analysis and design, based on "the book" but relying on experienced project managers, prior business knowledge and customer involvement. The modifications and extensions (mainly reports) were implemented and tested module by module. The company has a policy to include technical training for the customer's IT people in the contract, to decrease the customer's dependence on the company after the development project is completed.

In summary, Alpha Corporation is characterised by a clear hierarchy and formal procedures and plans that are carefully monitored. The contract with the customer is the basis

for everything else. The programmers are not in contact with the customers. It is the project manager's responsibility to communicate with the customer, find things out, and let the programmers do their work undisturbed. Implementation is the responsibility of another group of people.

5.3 Case study 2: A mixed-ownership company producing packaged software locally

Beta Corporation was established in 1994 by two technical persons and some progressive investors; nowadays the shareholding is 35% Nigerian and 65% foreign. All investors understood that high-tech companies will not give immediate returns, so they invested for the long haul. Initially four programmers out of 120 applicants were hired and trained. Currently they have around 40 people, out of which nine are active in software development. Initially the company wrote customized software for selected clients. However, as most demand was for accounting software, the company ended up writing accounting packages. For the original design and initial assistance, they enlisted "one brilliant accountant". He designed a simple yet powerful accounting software. Realizing that it was not cost-effective to try to design an accounting package from scratch every time a new customer came along, the company decided to take the big step to start to develop packaged software. We interviewed the Managing Director about that software package development project.

The project started in early 1996 and the accounting package has been sold since mid-1998. The company has now about 60 installed sites (manufacturing, construction, trading, government subsidiaries) and the sales are increasing. To manage the implementation of so many sites, the company relies on external accounting firms that have been trained in the installation and running of the package. The training and certification program to accountants is similar to the Microsoft Certified Professional program. The package runs on Windows and is developed on Visual FoxPro. The latest technical challenge is to meet the Microsoft COM specifications.

The founders, though familiar with programming and computers, had no prior experience in packaged software development, or in large-scale development efforts. These two constraints made it initially difficult to create a structured project plan. The other problem was not being able to recruit people with the needed skill sets. In the initial stages the employees had to be trained for programming, and design issues were by necessity left to a few people. Gradually some of the programmers were able to take up part of the design job. The tradition of the company in recruiting new programming staff is that more emphasis is laid on intelligence and brightness, not just on technical knowledge and education.

The project structure was very informal and flat. The primary information of business knowledge for the design of the systems came from customers and accountants. The application was developed in stages, meaning that the core design had to be revised on several occasions to accommodate new modules and features. Nowadays customer feedback is acquired mostly indirectly through implementors.

Technical and documentation standards have been developed gradually, as well as an in-house version management system. Each new project is documented in a special format, which includes a user requirement specification, database schema, functional specification, documentation of public methods and objects, and an outline of any graphical element of the design.

The development process is continuing. One version replaces another version, and minor revisions are constantly released to fix bugs or add features. The project management model finally adopted is based on MSF model of versioned releases. The cycle has four steps: 1. envisioning (in brainstorming sessions), 2. planning (assigned to a responsible individual), 3. developing (assign for programmers, coordinated by the functional definer and supervised by head of programming), and 4. stabilization (testing and fixing). While the company now has several people able to envision, design and implement new business modules, the skills for changing the underlying platform into the new technology and developing a structured plan to move the existing code to the new platform are scarce. The task of designing a blueprint for these structural changes falls at the present on one or two individuals.

Beta is gradually giving up the accounts software business because of the high level of competition. They are now involved in developing a taxation application for local governments in a pilot setup but with an intention to make it into a packaged product again.

In summary, Beta Corporation has a very flat and informal organization, though more structures have gradually evolved. Initial design is done jointly in a brainstorming fashion but the actual technical implementation is divided to individuals. There is, however, a strong interest to keep the results "disciplined" by recording the versions, modifiers and bugs, as well as by following strict standards. A flat informal structure relies to a large extent on individual responsibility and initiative, and great value is therefore placed on recruitment. The customer contacts are organized almost solely through well-trained implementors who are regarded as an important competitive advantage.

5.4 Case study 3: A small locally-owned company producing tailor-made systems

Gamma Corporation was established more than ten years ago for IT training, software development and some engineering. The company now has 35–40 employees altogether in Lagos and Abuja (the new capital city). Currently the focus is on human resource management systems, which are customised to each company. We interviewed an executive manager with a university career before joining the company. The customer in the project in question was a bank.

The technology used by the company is Oracle, Unix and Java with Windows workstations. Medium and small customers use SyBase and Microsoft databases because of the cost factor. Software development is based on high-level tools like Oracle Designer, Visual Basic and JBuilder.

The customer had an old in-house developed system for human resources management, but the technology was not the year 2000 compatible and they wanted to have a new application quickly. Gamma Corporation got to know about that through a training contact and demonstrated their software for the customer's IT people and users. By mid-1998 the bank decided to procure the new system from Gamma.

Very formal but less detailed requirements were presented by the customer, based on the previous system. The implementation team was established and the team defined the schedule, resources, etc. into a project plan. The project manager of the software company then produced a technical design and implemented it with rapid prototyping, module by module. The bank was keen on quality assurance, so a quality assurance team tested each module in terms of screen design standards, documentation standards, etc. – not so much in

terms of functionality. After that there was an acceptance test by the users, and then the module was moved to production environment and the implementation was started. A lot of new requirements were introduced by the management at this time, mainly reports. The customer initially gave six weeks for development, which was unrealistic, but their IT people "talked sense to the top management" and nine months of serious work was spent in practice. The IT people on both sides wanted to have a good system that "makes the users happy at the end". Most of the modules were in production use by the time of the interview, but there had not yet been time to train everybody.

The project organisation had two parts. On the client side there was a steering committee consisting of heads of relevant departments, head of audits, head of IT (female), and the project leader as a non-member. The project team was lead by a customer representative (non-IT person) and included users, IT persons of the customer, an audit representative, and Gamma Corporation's technical persons. The steering committee met monthly and the project team every week or so, also informally in smaller groups as necessary. The attitude and the skills of the project leader are crucial. On Gamma's side, the client services manager was involved on a policy level, the project director was a senior person with understanding of the business domain. Senior programmers and analysts were also involved in client contacts, requirements analysis and technical design, while young programmers concentrated on the technical tasks.

At various times 3–5 technical persons were involved in the project, two of whom were female. All technical staff at Gamma have at least a Bachelor's degree in Computer Science, some have post-graduate degrees. Since the company is also a training institution, they put staff on courses both in-house and occasionally outside. The best training for the staff, however, is to learn by doing.

In terms of development methods, the company takes advantage of the high-level tools (Oracle Designer). They have standards for screens, security, on-line help, documentation, reports, etc. The standards are more heavily used when developing from scratch – in customising an existing package the tools guide the work. Database design is considered very crucial because of some troubles years ago, there are very strong standards on that area, and university education in database design is considered inadequate. On project management methods they don't want to be too heavy, just to keep the project on track when there are "a few guys who come together and get things going".

In summary, Gamma Corporation pays a lot of attention to the high-level technical tools and standards of systems development as well as staff training. Flexibility and ability to react fast are regarded as a competitive asset, both in terms of the software technology and the project procedures. User satisfaction is highly appreciated, and guaranteed through involving them closely in the projects.

6. DISCUSSION

6.1 Assessment of the Nigerian software industry from the healthcare perspective

The companies selected for the survey are probably more "advanced" than software companies in Nigeria in average, since they are members of the Computer Association of Nigeria and known to have some software activities. The companies selected for the case

studies, although presenting different categories, are of course even more "advanced". Systems development practice in the smallest and most recently established software companies is thus probably not quite as professional and efficient as our results would indicate. However, the industry has clearly matured and is capable to provide an important contribution to the socio-economic development of the country.

The preliminary results paint a picture of a well established and professionally ambitious software industry, divided into a large number of fairly small companies, struggling with many socio-economic and infrastructural constraints. When the customer is a big company with money and experience in computerisation, then the systems development work is efficient and professional, and profitable for both parties. Banks are a prime example, and international enterprises have an additional advantage of being less constrained by local problems.

Small and even medium size customers, on the other hand, are still only in the beginning of computerising their activities, experiencing a lot of problems with infrastructure and economy, and having few resources for information systems development. Projects in these companies require a lot of "holding hands" so that the customers can truly understand their requirements and the potential of IT in facilitating them. Consequently more time and money is spent than in big and experienced companies.

The advantage of the local companies over foreign competition is in providing support services on the spot, being able to customise, and of course knowing the requirements of the Nigerian customers better. Better implementation services are also an advantage. Consistency and determination in systems development is greatly facilitated by having high-level development tools, as in Gamma Corporation, or by having a foreign or locally developed package as the basis, as in Alpha and Beta Corporations.

Typical Nigerian software companies, and particularly the projects, are quite small when compared to the kind of projects implicit in almost all software engineering literature in the industrialised countries (cf. Hoch *et al.*, 1999). While much of the methodological literature, both in SE and in IS, is regarded as much too heavy by many practitioners in the "North", Nigerian practitioners have an even greater need for "minimal but sufficient" methodologies adjusted to small projects with few IT professionals and inexperienced customers. Close relations between researchers and practitioners are needed to provide the latter with appropriately adjusted methods, techniques and skills (Korpela *et al.*, 2001 a).

The big customers provide the local software industry with an opportunity to live and develop. Hopefully the software industry can then expand their operations to small and medium size companies as well in a greater scale, and even to public sector domains like healthcare and education which are important to the country but financially less resourceful.

It seems that the software industry in Nigeria is technically and methodologically capable of providing the healthcare organisations in the country with the kind of software and information systems required, if the customer side can afford the job. The critical factor is to pool the existing demand in the public and private sectors of healthcare together to the extent that will create a profitable market segment. That can be done by the government, by an international development financier, or by an insightful private risk investor.

Regarding the specific case companies' potential in the healthcare sector, Alpha

Corporation deals with big customers and big money. They are not interested in minor applications or in developing something indigenous. Only if something "large" would be ordered by the government, they might be interested. Beta Corporation would be highly experienced in conducting a pilot project efficiently, and they would be interested in and capable of producing a package. They are not interested in tailored applications, and they want to see a sufficiently large market niche where local companies have an advantage. The healthcare sector might attract them, but they have no domain expertise. Gamma Corporation would certainly be interested in the healthcare sector. Their strength is in user satisfaction and in tailoring, but their way of working is not that efficient. They have no domain expertise, so major risks would be involved, particularly since the customers in the healthcare sector are inexperienced in computer systems as well. Thus none of the case companies is immediately ready to embark on healthcare applications, but all of them might get involved with certain preconditions.

6.2 Applicability of the research methodology

The research methods have developed during the study and are certainly not yet fully developed. It proved more difficult than we anticipated to find the right questions and the appropriate format for the "landscape view" survey. Particularly the procedures and practices used in the software companies are not vividly captured by a questionnaire, which must be short and quick enough that the busy managers and experts will fill it at all. The case studies, on the other hand, provided much more insight and material during fairly short visits. The downside of the case studies is the amount of work needed in processing the material, and of course the limitations of the sample size.

The activity-theoretical research framework proved practicable in the case studies, and focused the attention to relevant issues. However, much remains to be done in adjusting the framework and the checklist to the specifics of systems development in Nigeria. Especially the interplay between activity-level developments and the broader social, economic and political contexts needs more analytical and theoretical work (Korpela *et al.*, 2001 c). The interviews were short and much of the activity networks around systems development projects remained obscure. A full-scale pilot study would have been necessary to improve the questions and the interview technique in general before the actual cases. Full insight into the work practice would require participant observation, which was beyond this project's resources. Finally, the case studies in this study remained *descriptive* analyses only. In the Activity Analysis and Development methodology, the next step were to involve the systems developers into *activity development*, i.e., into designing improved practices for themselves to overcome the limitations identified in the analytical phase (Korpela, 1999). That had to be left to a possible second phase of this long-term research initiative.

For the Finnish researchers it was absolutely indispensable to have a joint research setting with true and equal partnership. The case studies could not have been feasible without a Nigerian researcher who understands the context and can interpret the nuances of the discussions. However, the Nigerian researchers as well were surprised by many of the findings in the companies. For instance, the amount of user involvement and the way it was emphasised greatly surpassed our expectations.

7. Conclusion

In this paper we presented theoretical and empirical research methods for studying information systems development as a work practice in a given socio-economic context. We applied the methods into providing a "landscape view" and three "in-depth portraits" of ISD in Nigerian software companies. As far as we know, systems development as a work practice has not been studied previously in any African country. The methods we applied are also new but proved practicable and provided a theoretically founded framework for the empirical study. The research procedure can be adjusted to other socio-economic contexts as well.

The preliminary results indicate that the software industry in Nigeria is technically and methodologically capable of providing the healthcare organisations in the country with the kind of software and information systems required, if the customer side can afford the job. There is also a need for "minimal but sufficient" software and IS development methodologies adjusted to small projects with few IT professionals and inexperienced customers. In the next phases of the INDEHELA-Methods project, we need to move from descriptive to constructive research and produce educational material, methods and curricula to respond to the needs of the practitioners.

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