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Abstract

The objective of this study is to describe the development environment, the activities performed, and the use of systems development methodologies in IS departments in South Africa. Our results indicate that organisations in South Africa are developing systems in a multiple platform environment, supported by multiple operating systems, using both local and wide area networks. Multiple programming languages are used for the development of new systems and for the maintenance of legacy systems. The most popular programming languages used in South Africa are Visual Basic, Cobol, Oracle, C, C++, and RPG. PC-based environments and operating systems seem to be the most popular.

IS departments of the responding organisations spend half of their time on maintenance, 31% of their time on the development of new applications and 15% on the customisation of packages. Focusing on the development of new applications, IS departments spend a third of their time on planning, analysis and design, another third on programming, and a third on testing, installation and evaluation.

We defined systems development methodologies as a combination of systems development techniques, process models, methods and approaches. Systems development techniques are used most intensively during the requirements analysis phase and during maintenance. The phased process model, characterised by successive phases such as feasibility study, requirements analysis, design, implementation and installation, is the most popular systems development process model, used most intensively in the IS departments. This is followed by evolutionary development in which the system is consciously planned to be delivered incrementally by subsystem or feature sets. Furthermore, systems development methods based on the structured approach are the most popular and used most intensively in the IS departments. Rapid application development and in-house developed methods are also popular.

Keywords: Systems development methodology, method, use, South Africa, developing country

Introduction

South Africa is a middle-income, developing country with well developed financial, legal, communications, energy and transport sectors. Despite this, serious economic problems remain from the apartheid era, especially the problems of poverty and lack of economic empowerment among the disadvantaged groups. Other problems that the country face are crime, corruption and HIV/AIDS (CIA 2002). One could argue that good quality information systems can help to address these problems, since modern societies are becoming more and more dependent on information systems (Rahim et al. 1998; Baskerville and Pries-Heje 1999).

However, since the late 1960's the quality of developed systems and the productivity of the systems development process continued to be problematic. This led to the term "software crisis" being used to describe problems inherent to systems development. The software crisis is well-documented (Conger 1994; Schach 1997; Ewusi-Mensah 1997). Faulty software is delivered late and exceeding the budget. During the 1968 NATO Software Engineering Conference held in Germany, the conclusion of the conference participants was that software engineering should use philosophies and paradigms similar to those used in other engineering disciplines to solve the software crisis. Since then a very large number of systems development methodologies have been developed (Bubenko 1986; Avison and Fitzgerald 1995). Jayaratna (1994) estimated the number of

systems development methodologies to be in the order of 1000, and since then many more systems development methodologies have been developed.

A widespread belief exists that adherence to systems development methodologies is beneficial to an organisation, and that using it can solve the software crisis (see Fitzgerald 1996 for a summary). However, there is a dearth of empirical studies of the use of systems development methodologies in practice, even in developed countries (Wynekoop and Russo 1997). Far less is known about their use in Africa, and more specifically South Africa. Soriyan et al. (2001) report about information systems development in Nigerian software companies. Only two previous studies have reported on systems development methodology use in South Africa, i.e. Erlank et al. (1991) and Addison and Hamersma (1996). The main focus of both studies was not systems development methodology use, and the number of participating organisations was not very high (52 and 13 respectively). Furthermore, these studies didn't take the degree of use into account. This means that an organisation that does not use a systems development methodology very often, is treated the same as one that uses it every day. Therefore these two studies have severe limitations as descriptions of methodology use in South Africa.

In this paper we will report the current systems development practices in South Africa. We will describe the development environment in the IS departments of the participating organisations, the activities performed in the IS departments, and the use of systems development methodologies. The paper is of interest to both the research community and to practitioners. In the research community not much is known about the use of systems development methodologies in practice, either in developed countries or in developing countries. Therefore we will address one of the research issues that was identified by Wynekoop and Russo (1997) as important, namely systems development methodology use. Furthermore, this research could assist practitioners when they benchmark their current systems development practice and consider its improvement. This is critical to organisations (especially South African organisations) when they enter the international market, or when they seek ISO 9000-3 or CMM certification. One of the ISO 9000-3 certification requirements is the use of formalised development processes, and therefore systems development methodologies are perceived to play a useful role. The CMM program also emphasises adherence to formalised development procedures (Humphrey 1989).

Systems Development Methodology

Trying to define a systems development methodology is no easy task. There is no universally accepted, rigorous and concise definition of an information systems development methodology (Avison and Fitzgerald 1995; Wynekoop and Russo 1997; Iivari et al. 2000). One of the first problems one encounters trying to define a systems development methodology is the "method" versus "methodology" debate. Researchers express the following views: Some argue that the term "methodology" has no place in information systems, because it literally means a "science of methods" (Baskerville et al. 1992; Schach 1997). Others argue that the terms can be applied interchangeably (Hardy et al. 1995; Saeki 1998). Another view is that methodologies encompass methods (Hirschheim et al. 1996) or that methods encompass methodologies (Palvia and Nosek 1993).

Furthermore, the very concept of a systems development methodology has suffered from conceptual ambiguity. Iivari and Maansaari (1998) discuss a number of conceptual problems related to the use of the term systems development method/ methodologies. They classify these problems into two dimensions of inconsistency, namely scope problems and category problems.

Avison and Fitzgerald (1995) argue that the term methodology is a wider concept than the term method, as it has certain characteristics that are not implied by method, i.e. the inclusion of a philosophical view. Therefore we define a systems development methodology as a combination of the following:

- A systems development approach(es):
  This represents the philosophical view on which the methodology is built. It is the set of goals, guiding principles and beliefs, fundamental concepts and principles of the systems development process that drive interpretations and actions in systems development (Iivari et al. 1998; Iivari et al. 2000). Examples of systems development approaches are the structured approach, object-oriented approach, information modelling, etc.

- A systems development process model(s):
  Wynekoop and Russo (1993) define a process model as a representation of the sequences of stages through which a system evolves. Some examples of process models are the linear life-cycle model and the spiral model.

- A systems development method(s):
  A method is a systematic approach to conducting at least one complete phase of systems development, consisting of a set of guidelines, activities, techniques and tools, based on a particular philosophy of systems development and the target system (Wynekoop and Russo 1993). Examples include OMT (Object Modelling Technique), IE (Information Engineering), etc.

- A systems development technique(s):
  Systems development techniques can be defined as a procedure, possibly with a prescribed notation, to perform a development activity (Brinkkemper 1996), for example entity relationship diagrams.

Survey

This study is part of a larger survey on SDM use in South Africa, which was conducted between July and October 1999. The 1999 IT Users Handbook (the most comprehensive reference guide to the IT industry in South Africa) was used and the 443 listed organizations were contacted via telephone to determine if they were willing to participate in the study. 213 organizations agreed to take part. A package of questionnaires was sent to a contact person in each organization who distributed it. This package consisted of one questionnaire to be answered by the IS manager, and a number of questionnaires to be answered by individual systems developers in the organization.[1] The number of developer questionnaires was determined for each organization during the telephone contacts. The response rate of the survey was as follows: 83 organizations (39%), 234 developers (26%) and 73 managers (34%) responded. The profiles of the participating organisations and the individual developers are summarised in Table 1 and Table 2 respectively.

Table 1. Profile of Responding Organisations (n=73)

	N	%
Business sector		
Primary sector		
• Agriculture	1	1.4
• Mining	5	6.8
Secondary sector		
• Manufacturing	29	39.7
• Electricity and water supply	1	1.4
• Construction	3	4.1
Tertiary sector		
• Trade	8	11.0
• Transport and communication	6	8.2
• Community services	7	9.6
• Financial and business	13	17.8
Organisation size		
1-50 employees	5	6.8
51-200 employees	8	11.0
More than 200 employees	60	82.2
IS department size		
1-5 employees	17	23.3
6-20 employees	23	31.5
20-50 employees	12	16.4
More than 50 employees	21	28.8

[1] Relevant parts of the questionnaires are available from the first author on request.

Development Environment

In order to describe the development environment in the IS departments, we gathered information on the development platforms, networks, operating systems and programming languages used for the development of new systems and the maintenance of legacy systems, as applied by Russo et al. (1996). In all instances IS managers were provided with a list of

alternatives, and they were asked to indicate which of the listed items were being used in their IS departments. It was possible to mark more than one item. Furthermore, managers could also specify items which were being used in the IS departments, but which were not included in the lists provided.

Development Platforms

The list of alternatives provided to describe the development platform included the following five items: Microcomputers, minicomputers, mainframes, workstations and other. The descriptive statistics of the development platforms used are presented in the first part of Table 3. Microcomputers are used in 69% of the IS departments, followed by workstations (58%), mainframes (53%) and minicomputers (46%).

Table 2. Profile of Responding IS Developers (n=234)

	N	%
Education		
Senior certificate (high school)	39	16.7
Certificate or diploma	79	33.8
University or technikon degree	75	32.1
Honours or Master's degree	36	15.4
PhD degree	0	0.0
Other	3	1.3
Missing	2	0.9
Experience in systems development		
None	4	1.7
Less than 1 year	14	6.0
1-2 years	21	9.0
3-5 years	51	21.8
5-10 years	53	22.6
More than 10 years	89	38.0
Missing	2	0.9

Networks

To determine what networks are being used in the IS departments, we provided managers with the following list of alternatives: Local area network, wide area network and other. The descriptive statistics of the networks used are presented in the second part of Table 3. In nearly all of the organisations (96%) local area networks is part of the development environment. Wide area networks are used in nearly 71% of the organisations, and in the "other" category, 3 managers indicated that they use the internet as part of their development environment.

Operating Systems

A summary of the operating systems used by the IS departments is presented in the last part of Table 3. Included in Table 3 are the operating systems listed in the questionnaire, and four additional operating systems (Unibasic Runtime, Unisys MCP, OS/400 and VSE/ESA) mentioned by the managers in the "other" category. The average number of operating systems supported by the

IS departments is 4.1. The Windows family of operating systems is the most popular operating system, and it is used in more than 75% of the IS departments. Unix is used in 53% of the organisations.

Table3. Development Environment in the IS Departments

Type	Number (n=72)	Percentage (%)
Development platform		
Microcomputers	50	69.4
Workstations	42	58.3
Mainframes	38	52.8
Minicomputers	33	45.8
Networks		
Local area network	69	95.8
Wide area network	51	70.8
Other (Internet)	3	4.2
Operating systems		
Windows 95	57	79.2
Windows NT	55	76.4
Unix	38	52.8
Windows 98	32	44.4
Netware	28	38.9
MVS/VM/VMS	20	27.8
DOS	19	26.4
Windows 3.x	12	16.7
OS/400	12	16.7
OS/2	9	12.5
Unisys MCP	5	6.9
VSE/ESA	3	4.2
Macintosh	1	1.4
Unibasic Runtime	1	1.4

Programming Languages

Managers were asked to indicate what programming languages are used in their departments for the development of new applications and for the maintenance of legacy systems. The programming languages used for the development of new applications are summarised in the second column of Table 4. The average number of languages used for the development of new applications is 2.9 per organisation. Visual Basic is used in 47% of the organisations, followed by Oracle, which is used in 24% of the organisations. A summary of the programming languages used for the maintenance of legacy systems is summarised in the third column of Table 4. The average number of languages used in the organisations for maintenance is 2.9. The most popular language on the list is Visual Basic, which is used for maintenance in 40% of the organisations. This is followed by Cobol, which is used in 35% of the organisations. Taking both development of new applications and maintenance into account, the six most popular programming languages reported in this study are Visual Basic, Cobol, Oracle, C, C++ and RPG.

Systems Development Activities of IS Departments

Activities Performed

Managers were asked to indicate what percentage of their IS departments activities are allocated to the development of new applications, systems maintenance and support, and package customisation. These results are presented in Table 5. Half of the IS departments' efforts are allocated to maintenance, 31% on the development of new applications, and 15% on the customisation of packages.

Table 4. Programming Languages Used in the IS Departments

	New development		Maintenance	
Programming language	**Number**	**%**	**Number**	**%**
Visual Basic	34	47.2	29	40.3
Oracle	17	23.6	16	22.2
C++	15	20.8	12	16.7
C	14	19.4	15	20.8
Cobol	13	18.1	25	34.7
RPG	12	16.7	12	16.7
Java	12	16.7	4	5.6
SAP	11	15.3	7	9.7
Natural/Adabas	10	13.9	10	13.9
Delphi	9	12.5	8	11.1
Powerbuilder	7	9.7	7	9.7
DB2	6	8.3	4	5.6
SQL	6	8.3	5	6.9
Sybase	5	6.9	4	5.6
Informix	3	4.2	4	5.6
Powerhouse	3	4.2	3	4.2
Clipper	3	4.2	5	6.9
Progress	3	4.2	3	4.2
Access	3	4.2	3	4.2
Smalltalk	2	2.8	0	0
BAAN	2	2.8	3	4.2
Magic	2	2.8	2	2.8
Pascal	1	1.4	4	5.6
Assembler	0	0	2	2.8
PL/1	0	0	2	2.8
Ingres	1	1.4	2	2.8
Clarion	1	1.4	2	2.8

Table 5. IS Departments' Activities

Activity	**Mean (n=72) %**	**0%**	**1 – 20%**	**21-40%**	**41-60%**	**61-80%**	**81-100%**
Development of new applications	31.4	5	27	19	11	9	1
Maintenance and support	50.4	1	9	27	12	14	9
Package customisation	15.2	18	37	9	4	4	0

Concentrating on the development efforts of IS departments, managers were also asked to indicate what percentage of the IS departments' development effort are allocated to systems planning, systems analysis, systems design, programming, testing, installation and evaluation. This is presented in Table 6. IS departments spend a third of their time on planning, analysis and design, another third on programming and a third on testing, installation and evaluation.

Table 6. Development Activities

Activity	Mean (n=65) %	0%	1 - 20%	21-40%	41-60%	61-80%	81-100%
Systems planning	10.4	2	62	1	0	0	0
Systems analysis	13.0	4	55	6	0	0	0
Systems design	12.7	6	57	2	0	0	0
Programming	29.2	6	20	26	10	3	0
Testing	14.0	1	58	5	1	0	0
Installation	9.2	4	59	1	0	1	0
Evaluation	5.3	15	49	0	1	0	0
Other	4.2	57	3	3	1	1	0

Systems Development Methodology Use

In accordance with our definition of systems development methodologies, we focus in this section on the use of systems development techniques, systems development process models, systems development methods and systems development approaches. Questions to measure systems development methodology use were included in both the developer and manager questionnaires. The data reported in this section were calculated as follows. The developer and manager data were aggregated to the organisational level, and the average of all the individual responses was calculated.

Systems Development Techniques

The list of techniques provided to the respondents was organised into four groups, namely techniques used during requirements analysis, techniques used during systems design, techniques used during the testing phase and techniques used during maintenance (Poo and Chung 1998). Respondents were asked to indicate on a scale from 1 (nominally) to 5 (intensively) the intensity with which systems development techniques were being used in the IS departments.

The average number of techniques reported per organisation is 16.6. A summary of the results of systems development techniques used in the IS departments are presented in Table 7. The percentage of organisation that indicated below average use (values < 3) of a systems development technique are presented in the fifth column of Table 7, those that indicated average use (values = 3) in the sixth column, and those that indicated above average use (values > 3) in the seventh column. The techniques were ranked based on the percentage of organisations that reported above average use. A comparison with the study by Erlank (1991) is presented in the last column of Table 7. Of special interest to us are the results of Erlank (1991), since these results reflect the situation in South Africa during 1989. The numbers reported by Erlank are the percentage of organisations that reported that they always use the technique. However, the intensity of use was not measured. Compared to our results, it is clear that IS departments in South Africa are using systems development techniques more intensively than in 1989. The ranking of the techniques also indicate that systems development techniques are used most intensively during the requirement analysis phase and during maintenance. It is interesting to note the low ranking of object-oriented techniques during the requirements analysis phase.

Systems Development Process Models

Based on Schach (1996), a list of process models was compiled. Respondents were asked to indicate to what extent the systems development practice of the IS department is based on the listed process models, on a scale from 1 (nominally) to 5 (intensively). It was possible to mark more than one item. The average number of process models used per organisation is 4. A summary of the results of systems development process models used in the IS departments are presented in Table 8. The percentage of organisation that indicated below average use (values < 3) of a systems development process model are presented in the fifth column of Table 8, those that indicated average use (values = 3) in the sixth column, and those that indicated above average use (values > 3) in the seventh column. The process models were ranked based on the percentage of organisations that reported above average use. Above average use for the phased process model is reported by 77% of the organisations. Evolutionary development is ranked second and spiral models last.

Table 7. The Use of Systems Development Techniques

Techniques	Number (n=77)	%	Mean	Below Average Use %	Average Use %	Above Average Use %	Erlank (1991) %
Requirement analysis							
Data normalisation	68	88.3	3.7	1.3	29.9	57.1	44
Data flow diagrams	65	84.4	3.5	9.1	19.5	55.8	33
Entity relationship diagrams	66	85.7	3.5	7.8	26.0	52.0	29
Data dictionary	64	83.1	3.5	7.8	27.3	48.1	50
Flowcharts	67	87.0	3.3	16.9	23.4	46.8	33
Joint application development (JAD)	54	70.1	3.4	9.1	20.8	40.3	
Prototyping/Rapid prototyping	55	71.4	3.2	11.7	32.5	27.3	12
Process dependency diagrams	42	54.6	3.0	11.7	22.1	20.8	
Object-relationship models	41	53.3	3.1	11.7	20.8	20.8	
Process decomposition diagrams	40	52.0	3.1	10.4	22.1	19.5	
Object-interaction models	30	39.0	3.0	10.4	11.7	16.9	
Object-behaviour models	25	32.5	2.9	10.4	10.4	11.7	
Entity life cycle diagram	34	44.2	2.5	22.1	13.0	9.1	
Design							
Transaction volume analysis	45	58.4	3.1	14.3	16.9	27.3	
Process hierarchy diagrams	48	62.3	3.1	13.0	24.7	24.7	
Decision tables/trees	42	54.6	3.2	11.7	20.8	22.1	2
Structure chart	35	45.5	3.2	5.2	20.8	19.5	19
Hierarchical input output diagrams	34	44.2	3.1	10.4	16.9	16.9	
Class tables	31	40.3	3.0	11.7	15.6	13.0	
Action diagrams	32	41.6	3.1	7.8	22.1	11.7	
Dialogue flow diagrams	23	29.9	2.8	7.8	16.9	5.2	
Nassi-Schneiderman diagrams	9	11.7	3.0	2.6	3.9	5.2	
Booch diagrams	11	14.3	2.1	9.1	5.2	0	
Warnier-Orr diagrams	2	2.6	2.3	1.3	1.3	0	2
Testing							
Top-down testing	52	67.5	3.4	7.8	22.1	37.7	
Walk throughs	42	54.6	3.3	3.9	28.6	22.1	21
Black-box testing	33	42.9	3.4	3.9	18.2	20.8	
Bottom-up testing	41	53.3	3.1	7.8	26.0	19.5	
White-box testing	22	28.6	3.3	6.5	9.1	13.0	
Maintenance							
Software change management procedures	60	77.9	3.8	5.2	16.9	55.9	
Configuration management procedures	51	66.2	3.2	16.9	16.9	32.5	
Documentation change management procedures	61	79.2	3.0	16.9	36.4	26.0	

Table 8. The Use of Systems Development Process Models

Process models	Number (n=77)	%	Mean	Below Average Use %	Average Use %	Above Average Use %
Phased process characterised by successive phases such as feasibility study, requirements analysis, design, implementation, installation	66	85.7	3.9	2.6	6.5	76.6
Evolutionary development in which the system is consciously planned to be delivered incrementally (by subsystem/ feature sets)	62	80.5	3.4	10.4	24.7	45.5
Concurrent development in which the analysis, design and implementation take place virtually concurrently	64	83.1	3.2	14.3	31.2	37.7
Prototyping using either paper prototypes (mock-ups) or computer-based prototypes	58	75.3	3.0	16.9	24.7	33.8
Spiral models characterised by successive spirals of analysis, design, prototype implementation, prototype use, evaluation	47	61.0	2.9	15.6	29.9	15.6

Systems Development Methods and Approaches

A list with a number of systems development methods was provided to the respondents. They were asked to indicate on a scale from 1 (nominally) to 5 (intensively) to what extent the IS department was using the systems development methods. It was possible to indicate more than one item. The average number of systems development methods reported by the organisations is 3.6. The use of no method, neither commercial nor in-house, was reported by 14% of the organisations.

A summary of the results of systems development methods used in the IS departments are presented in Table 9. In Table 9 the methods are organised according to the approach on which they are based, following the classification by Iivari et al. (2000):

1. Structured approach: modelling of data flows, processes (data transformation)
2. Information modelling: conceptual structure of the data/database (entities, relationships)
3. Business process-oriented: business processes to be supported by the computer-based system
4. Object-oriented approach: object class structures (inheritance support)
5. Socio-technical approach: interdependence of the technical subsystem (computer system) and social subsystem (work system, business process)
6. Soft systems methodology: analysis of human activity systems.

We also included rapid application development and in-house developed methods.

The percentage of organisation that indicated below average use (values < 3) of a systems development method are presented in the fifth column of Table 9, those that indicated average use (values = 3) in the sixth column, and those that indicated above average use (values > 3) in the seventh column. A comparison with the study by Erlank (1991) is presented in the last column of Table 9. The methods were ranked based on the percentage of organisations that reported above average use. When we consider the results of Table 9, it is clear that systems development methods based on the structured approach are the most popular and used most intensively in the IS departments. This is followed by rapid application development and in-house developed methods. Compared to the results of Erlank (1991), it is clear that IS departments in South Africa are using systems development methods more intensively than in 1989.

Table 9. The Use Systems Development Methods

Methods	Number (n=77)	%	Mean	Below Average Use %	Average Use %	Above Average Use %	Erlank (1991) %
Structured approach							
STRADIS (Structured Analysis, Design and Implementation of Information Systems)	30	39.0	3.6	2.6	9.1	27.3	0
SSADM (Structured Systems Analysis and Design Method)	24	31.2	3.3	5.2	10.4	15.6	8
SSAD (Structured Systems Analysis and Design)	20	26.0	3.5	1.3	10.4	14.3	
SASD (Structured Analysis and Structured Design)	15	19.5	3.6	2.6	3.9	13.0	
Method/1	6	7.8	3.1	1.3	2.6	3.9	10
Foundation	1	1.3	4.0	0	0	1.3	
LBMS	1	1.3	4.0	0	0	1.3	
Navigator	7	9.1	3.0	2.6	5.2	1.3	
YSM (Yourdon Systems Method)	4	5.2	2.5	2.6	2.6	0	
Information modelling							
IE (Information Engineering)	18	23.4	3.1	1.3	2.6	19.5	6
Oracle Case*Method	1	1.3	4.5	0	0	1.3	
Business process-oriented							
Process Innovation (Business process re-engineering)	22	28.6	3.2	5.2	11.7	11.7	
Oracle Designer 2000	1	1.3	4	0	0	1.3	
Rapid Application Development							
RAD (Rapid Application Development)	43	55.9	3.2	10.4	20.8	24.7	
Object-oriented							
UML (Unified Modelling Language)	9	11.7	3.5	1.3	3.9	6.5	
OOA&D (Object Oriented Analysis and Design by COAD and Yourdon)	9	11.7	2.9	5.2	2.6	3.9	
OSA (Object-oriented Systems Analysis)	8	10.4	3.1	2.6	3.9	3.9	
OMT (Object Modelling Technique by Rumbaugh)	8	10.4	3.1	0	7.8	2.6	
Objectory	3	3.9	3.6	0	1.3	2.6	
OOA (Object Oriented Analysis by Shlaer and Mellor)	2	2.6	3.5	0	1.3	1.3	
Fusion	1	1.3	4.0	0	0	1.3	
OOSE (Object Oriented Software Engineering by Jacobson)	5	6.5	2.2	3.9	2.6	0	
Booch	3	3.9	2.9	0	3.9	0	
MOSES	0	0	-	0	0	0	
Select perspective	1	1.3	3.0	0	1.3	0	
Socio-technical approach							
ETHICS (Effective Technical and Human Implementation of Computer-based Systems)	2	2.6	3.5	1.3	0	1.3	
Soft Systems Methodology							

Methods	Number (n=77)	%	Mean	Below Average Use %	Average Use %	Above Average Use %	Erlank (1991) %
SSM (Soft Systems Methodology)	0	0	-	0	0	0	
Multiview	0	0	-	0	0	0	
In-house							
In-house	23	29.9	4.3	1.3	3.9	24.7	6
Other							
Infomet	4	5.2	3.8	0	2.6	2.6	10
SREM (Systems Requirements Engineering Methodology)	3	3.9	3.7	0	1.3	2.6	
JSD (Jackson Systems Development)	6	7.8	2.9	2.6	3.9	1.3	
Rhythm	1	1.3	5.0	0	0	1.3	
MITP	1	1.3	4.0	0	0	1.3	
ERP (JD Edwards)	1	1.3	4.0	0	0	1.3	
Uniface	1	1.3	5.0	0	0	1.3	
CDM/APT	1	1.3	4.0	0	0	1.3	
Microsoft Solutions framework	1	1.3	4.0	0	0	1.3	
Euromethod	1	1.3	2.0	1.3	0	0	

The results of Table 9 were aggregated based on the approaches, and the results are presented in Table 10. The structured approach is the most popular, since 60% of the organisations indicated that they use at least one method based on the structured approach, and 42% of the organisations indicated above average use for at least one method based on the structured approach. This followed by rapid application development, since 56% of the organisations indicated that they use rapid application development.

Table 10. The Use of Systems Development Approaches

Approach	Number (n=77)	%	Mean	Below Average Use %	Average Use %	Above Average Use %
Structured approach	46	59.7	3.7	3.9	14.3	41.6
Rapid application development	43	55.8	3.2	15.6	15.6	24.7
Object-oriented approach	20	26.0	3.7	3.9	5.2	16.9
Business process-oriented	23	29.9	3.2	6.5	10.4	13.0
Information modelling	18	23.4	3.1	3.9	10.4	9.1
Socio-technical approach	2	2.6	3.5	1.3	0	1.3
Soft Systems Methodology	0	0	0	0	0	0
Other	19	24.7	3.6	5.2	5.2	14.3

Summary

In this study we described the development environment and the use of systems development methodologies in South Africa. The results indicate that organisations in South Africa are developing systems in a multi-platform environment, supported by multiple operating systems, using both local and wide area networks. This confirms the results of Russo et al. (1996), who found that organisations are supporting a variety of development environments, on multiple hardware and software platforms. PC based environments, operating systems and programming languages seem to be the most popular. Multiple programming languages are used for the development of new systems and for the maintenance of legacy systems. The most popular programming languages used in South Africa are Visual Basic, Cobol, Oracle, C, C++, and RPG.

The IS departments of the responding organisations spend half of their time on maintenance, 31% of their time on the development of new applications and 15% on the customisation of packages. It is interesting that 15% of the IS departments' efforts are spent on the customisation of packages. This is clearly less than reported by Fitzgerald (1998) who found a high level (40%) of package use and customisation among the organisations in his study. The difference may be explained by the higher proportion of small organizations (41% with 1-100 employees) and small IS departments (44% with 1-5 employees) in Fitzgerald's sample than in ours. Focusing on the development of new applications, IS departments spend a third of their time on planning, analysis and design, another third on programming, and a third on testing, installation and evaluation.

Systems development techniques are used most intensively during the requirements analysis phase and during maintenance. The phased process model, characterised by successive phases such as feasibility study, requirements analysis, design, implementation and installation, is the most popular systems development process model, used most intensively in the IS departments. These results are in accordance with the results of Poo and Chung (1998), who also found the phased process to be the most popular process model used among the respondents, and the spiral model the least popular.

Furthermore, systems development methods based on the structured approach are the most intensively used methods in the IS departments, followed by rapid application development and in-house developed methods. This suggests that South African organizations may have been somewhat conservative in their selection of systems development methodologies. When we compare our results with a previous study performed in South Africa by Erlank (1991) it is clear that IS departments in South Africa are using systems development techniques and methods more intensively than in 1989.

When we consider the use of techniques and methods based on the object-oriented approach, very few organisations indicated above average use. This is in sharp contrast to the fact that Visual Basic and C++ (which are object-based) are among the six most popular programming languages used for the development of new systems and the maintenance of legacy systems. This confirms the findings of Pancake (1995), who report that many developers are reluctant to accept object-oriented systems development wholeheartedly. However, Post and Kagan (2001) and Ambler (2001) argue that the advantages of object-orientation can only be achieved if it is used throughout the entire systems development process. Assuming that these organisations use Visual Basic and C++ in order to obtain the benefits associated with object-orientation, one might ask whether these benefits are actually realised.

This paper reported purely descriptive statistics on systems development methodology use in South Africa. It is based on a wider study of systems development methodologies that reported among others the factors that influence the organisational and individual deployment of systems development methodologies (Huisman 2000). Further analysis of the collected data is still under way. We wish that the further analysis would reveal more theoretical and generalizable results.

References

Addison, T.M., and Hamersma, S. "Critical Success Factors for Implementing CASE at a Selection of Companies in South Africa", South African Computer Journal (18), 1996, pp. 4-9.

Amber, S.W. The Object Primer: The application developer's guide to Object Orientation and the UML, Cambridge University Press, 2001.

Avison, D.E., and Fitzgerald, G. Information Systems Development: Methodologies, Techniques and Tools, McGraw-Hill Publishing Company, Berkshire, England, 1995.

Baskerville, R., Travis, J., and Truex, D. "Systems without method: The impact of new technologies on Information Systems development Projects", in Kendall, K.E., Lyytinen, K., and DeGross, J.I. (eds), The impact of Computer Supported Technologies on Information Systems Development, Amsterdam, 1992, pp. 241-269.

Baskerville, R., and Pries-Heje, J. "Knowledge Capability and Maturity in Software Management", Data Base (30:2), 1999, pp. 26-42.

Brinkkemper, S. "Method engineering: engineering of information systems development methods and tools", Information and Software Technology (38), 1996, pp. 275-280.

Bubenko, J.A. "Information systems methodologies-a research view", in Ollie, T.W., Sol, H.G., Verrijn-Stuart, A.A. (eds.), Information Systems Methodologies: Improving the practice, North Holland, Amsterdam, 1986, pp. 289-318.

CIA, The World Factbook 2002, **http://cia.gov/cia/publications/factbook/geos/sf.html**.

Conger, S. The New Software Engineering, Wadsworth Publishing Company, Belmont, California, 1994.

Erlank, S., Pelteret, D., Meskin, M. "An analysis of the usage of system development methods in South Africa", South African Computer Journal (4), 1991, pp. 68-77.

Ewusi-Mensah, K. "Critical issues in Abandoned Information Systems Development projects", Communications of the ACM (40:9), 1997, pp. 74-80.

Fitzgerald, B. "Formalized systems development methodologies: a critical perspective", Information Systems Journal (6), 1996, pp. 3-23.

Fitzgerald, B. "An empirical investigation into the adoption of systems development methodologies", Information & Management (34), 1998, pp. 317-328.

Hardy, C.J., Thompson, J.B., and Edwards, H.M. "The use, limitations and customization of structured systems development methods in the United Kingdom", Information and Software Technology (37:9), 1995, pp. 467-477.

Hirschheim, R., Klein, H.K., Lyytinen, K., "Exploring the Intellectual Foundations of Information Systems", Accounting, Management and Information Technologies (6:1/2), 1996, pp.1-64.

Huisman, H.M. The deployment of systems development methodologies: A South African experience, Ph.D dissertation, Potchefstroom University for CHE, Potchefstroom, South Africa, 2000.

Humphrey, W.S. Managing the Software Process, Addison-Wesley, Reading, Massachusetts, 1989.

Iivari, J., and Maansaari, J. "The usage of systems development methods: are we stuck to old practices?", Information and Software Technology (40), 1998, pp. 501-510.

Iivari, J., Hirschheim, R., Klein, H.K. "A Paradigmatic Analysis Contrasting Information Systems Development Approaches and Methodologies", Information Systems Research (9:2), 1998, pp. 164-193.

Iivari, J., Hirschheim, R., Klein, H.K. "A dynamic framework for classifying information systems development methodologies and approaches", Journal of Management Information Systems (17:3), 2000, pp. 179-218.

Jayaratna, N. Understanding and Evaluation Methodologies, A Systematic Framework, McGraw-Hill, London, 1994.

Palvia, P., Nosek, J.T. "A field examination of system life cycle techniques and methodologies", Information and Management (25), 1993, pp. 73-84.

Pancake, C.M. "The promise and the cost of object technology: a five-year forecast", Communications of the ACM (38:10), 1995, pp. 33-49.

Poo, D.C.C., and Chung, M.K. "Software engineering practices in Singapore", Journal of Systems and Software (41:1), 1998, pp. 3-15.

Post, G., Kagan, A. "User requirements for OO CASE tools", Information and Software Technology (43), 2001, pp. 509-517.

Rahim, M., Seyal, A.H., Raham, N. "Use of software systems development methods. An empirical study in Brunei Darussalam", Information and Software Technology (39), 1998, pp. 949-963.

Russo, N.L., Hightower, R., and Pearson, J.M. "The failure of methodologies to meet the needs of current development environments", in Jayaratna, N., and Fitzgerald, B., (eds.) Lessons learned from the Use of Methodologies: Fourth Conference on Information Systems Methodologies, 1996, pp. 387-394.

Saeki, M. "A meta-model for method integration", Information and Software Technology (39), 1998, pp. 925-932.

Schach, S.R. Software engineering with Java, Richard D. Irwin, USA, 1997.

Soriyan, H.A., Mursu, A.S., Akinde, A.D., Korpela, M.J. "Information systems development in Nigerian software companies: Research methodology and assessment from the healthcare sector's perspective", Electronic Journal for Information Systems in Developing Countries (5:4), 2001, pp. 1-18.

Wynekoop, J.L., and Russo, N.L. "System development methodologies: unanswered questions and the research-practice gap", in DeGross, J.I et al. (eds.) Proceedings of the Fourteenth International Conference on Information Systems, Orlando, FL, 1993, pp. 181-190.

Wynekoop, J.L, and Russo N.L "Studying system development methodologies: an examination of research methods", Information Systems Journal(7), 1997, pp. 47-65.