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ORIGINAL PAPER

Bridging Worlds: Information Systems Development Through Cross-Cultural Comparison

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Abstract This paper reports a case study where soft systems methodology (SSM) was used to help automate a largely manual administrative (examination) information system in a Pakistani university. Various design suggestions for information system improvements, both administrative and IT-supported were made (and implemented) through comparison with another university in Denmark which is well supported by computer systems. An action design research approach with an interpretative epistemology/ontology was adopted. Though the single comparison experience is difficult to generalise, we conclude that SSM (with some adaptations) can enable a socio-technical comparison and design effort and offer a prototype process. The comparison stimulates forward-looking design, but great care must be taken to accommodate cultural differences, and further research is necessary to integrate more sophisticated cultural analysis tools into the design process. The research extends SSM in information system development—from a single situational analysis to a comparative process and can be adapted as a pattern for practitioners with similar automation needs.

Keywords Information systems development · Soft systems methodology · Interaction and transformation · Action design research · Cultural analysis

Introduction

Managers in developing countries still face many problems with the automation of administrative systems which may, at first sight, appear to be easily solvable to observers in developed countries. This article reports on part of an information system development (ISD) effort in a major Pakistani university's examination office. The largely manual

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system was overloaded by increases in student numbers, and the university's management in response decided to automate the examination office with information technology (IT). Collaborating researchers in Denmark consider this problem solved; their examination system has been automated for some years and functions relatively smoothly. One paradigm for designing such a collaboration can be described as 'technology and knowledge transfer and adaptation to social conditions' (Avgerou 2008). Here the starting point is the automated system in Denmark, which can serve as a model for the Pakistani university with suitable modifications. However, direct technology transfer, without taking local cultural conditions into account is known to be problematic (Heeks 2002). A second paradigm could be 'socially-embedded action' (Avgerou 2008): now the focus should be the local conditions and requirements of the Pakistani university and the Danish researchers should help to orchestrate the process of understanding and implementing these. Here the Danish automation experience may come to be undervalued. In either case there are a number of problematic design-actuality gaps (Heeks 2002) in cross-cultural ISD that often lead to failure and should be avoided. These refer to gaps between the intentions of the designers of the information system and the realities (actualities) of that its users experience. For instance there is often a gap between assumptions of hard rationality designed into an information system, and the soft political actualities in the use situation. The challenge for the collaborative research is therefore to learn from both positive and negative experiences in the Danish situation to improve the development in Pakistan without introducing inappropriate or dysfunctional changes. Since the collaboration took place at a relatively early stage in the Pakistan development, a socio-technical approach is adopted, where work process and IT are considered together. A holistic view of information systems, understood as both social systems and as collections of designed technology artefacts is adopted from Checkland and Holwell (1998). The need to be sensitive to cultural differences rules out conventional engineering methodologies focusing exclusively on requirements and software design (Jayaratna 1994) and soft system methodology is the preferred action design research (ADR) toolbox. The chosen research strategy is structured comparison: the two environments should be compared in order to help learn the way forward: thus we try to steer a course in between a technology transfer paradigm and socially-embedded action paradigm. We address the research question: 'how can you develop a new information system through structured cross-cultural comparison?'—where the premise is that experience from a more IT-dependent information system in a comparable area should inform the development. The article is organised as follows: the research situation is explained, the relevant theoretical constructs from SSM which guide the research are introduced and a research strategy based on ADR is elaborated. A variety of analysis and design products are presented which focus on a structured comparison process, together with the actions taken in the situation. The major learning points, together with the proposed process are elucidated and summarised in the discussion and conclusion.

The Research Situation

There are 128 (72 public and 56 private) universities in Pakistan, regulated by the Higher Education Commission (HEC), which has taken many initiatives to promote the use of information and communication technologies (ICT) and to automate manual administrative systems. Because of some sensitivity to parts of the following analysis which can be construed as criticism, both universities involved are kept anonymous; the Pakistani University involved in the study will be referred to as PKU and the Danish university as

DKU. PKU is ISO-certified for its use of standardized business processes, and its responsible and reliable administration. There are twenty departments at PKU (and some affiliated colleges and institutes) offering undergraduate and postgraduate study programs with written examinations at the end of semesters. All university examinations are conducted and managed by a specialized examination department, headed by the Controller of Examinations with more than fifty staff members. There are three sections in the examinations department: the conduct section, the secret section, and the computer section. The conduct section is responsible for the conduct of examinations including scheduling timetables, handling the secret question papers and holding the examinations, whilst the secret section deals with post-examination activities, interacts with teachers for results processing, and develops result ledgers. The computer cell is responsible preparing and printing certificates and issuing them to students. All these activities are conducted according to standard operating procedures (SOPs) developed according to ISO standards. However, they are predominantly manual and based on ledgers, with many clerical staff performing routine, repetitive and often duplicated tasks. Expanding teaching activities and increasing student numbers have put the examinations department under considerable pressure in recent years. Overload problems are manifested in errors on certificates and rework, processing delays, staff frustration and dissatisfaction from both students (whose careers are affected) and professional bodies such as the Pakistan Medical and Dental Council, Pakistan, Medical Association and Pakistan Engineering Council, and HEC, who are consumers of examination information. PKU's management therefore decided to modernise. In the absence of reliable local software suppliers or appropriate proprietary systems they established a software incubator led by the head of computer science. A group of nine including faculty members, a consultant, the examinations officer and a full time software developer was tasked with organizing the modernisation effort. This study, which is built on earlier studies at PKU as part of the modernisation, forms part of this effort. The examination officer at PKU visited Denmark and studied the DKU examination system for a period of 4 months. He was responsible for liaison between universities and took the role of practitioner-researcher. He remained in almost daily contact with his home university. He reported his findings to the committee at home and contributed design suggestions for the modernisation. DKU is internationally recognised for its problem-based learning approach. 22 different departments in five faculties offer 60 undergraduate and postgraduate programs to more than 14,000 students. The mode of examination has traditionally been oral, with some exceptions. Organization is based on a flat management structure where little formal hierarchical bureaucracy exists. Due to a centralized examinations database provided by the state, there is no centralized examinations department, and departmental secretaries act as examinations coordinators.

As a consequence the research process should be capable of

- addressing both research and practical issues,
- developing visions and detailed suggestions for both administrative and IT improvements: the need to address social and political issues (such as possible resistance in relation to job restructuring or downsizing as a result of automation) as well as technical design issues in the new computer systems,
- communicating with stakeholders with a variety of backgrounds,
- structuring an unclear, multi-faceted problem,
- structuring a comparison between two universities and a reasoning process behind decision-making at PKU,
- allowing for cultural differences between the two universities.

SSM in ISD

Soft systems methodology (Checkland and Scholes 1990; Checkland and Holwell 1998; Checkland 1981, 2000) has been used in the development of information systems for over 20 years. It has been widely used as a problem-structuring tool for information management, information strategy and business analysis. 'Soft systems methodology and action research can both help in addressing ill-structured problems faced by managers, in collaboration with stakeholders using questioning and reflection. Both lead to an increased understanding about the problem situation' (Sankaran 2009). System development is considered a 'domain of ideal use' for SSM (Baskerville and Wood-Harper 2001). Many attempts have been made to integrate it with conventional ISD methods (Avison and Wood-Harper 1990; Bell and Wood-Harper 2003). The starting premise is that 'information systems are part of social systems, and their use cannot be specified wholly in technical terms' (Stowell 1995). Instead a variety of social, cultural and political factors are taken seriously, driven by a predominantly managerial, rather than an engineering logic. Traditional systems analysis methods in Checkland's understanding (including most of the methods conventionally used for ISD), assume that the world is made up of systems that can be rationally analysed (hard systems), whereas the soft systems tradition uses systems theory as a series of conceptual devices for investigating and articulating problems in purposeful human activity. Human activity is taken as subjective and open to interpretation, and social reality assumed to be constructed and re-constructed by social actors. Thus the underlying ontology and epistemology of SSM, at least in Checkland's later work, is interpretive, or critical, rather than positivist (Rose 1997). SSM is therefore a better candidate than traditional ISD methods for addressing technical and administrative issues simultaneously, and for tackling different cultural perspectives. Though Mode 1 SSM was based on a defined seven-stage model (Checkland 1981), Mode 2 (Checkland and Scholes 1990) was intended to be more free-wheeling: internalised SSM concepts could be used in a more improvisatory way, complemented by social, political and interventional analysis. There is therefore a tradition of adopting SSM to more specialised analysis and design tasks, which this work falls into. SSM's tools (rich picture, root definition, conceptual model) are widely known, easy to learn and do not require specialist engineering knowledge to interpret, so the learning overheads in our communication process are relatively low. We adopt several of Checkland's basic premises as starting points for our work. He distinguishes between data, capta (data selected for capture in the information system) information and knowledge. An administrative system in an organisation is conceptualised as two human activity systems: a serving system and a system which is served. The underlying system of purposeful activity (Fig. 1 activity 6—here exam management), often represented by primary task (work process) conceptual models, is served by a system of information processing, which can have an IT component (Fig. 1 activity 7). Checkland's understanding of organisation is as a series of intentions, interpretations and accommodations, rather than the traditional goal-seeking model, and this is expressed in a relatively detailed way in the processes of organisational meaning (POM) model (Checkland and Holwell 1998) (Fig. 1).

The POM model brings together many facets of Checkland's thinking, including the interpretive and communicative action aspects, appreciative settings as cognitive filters, his characterisation of information and the broad concept of an information system as an organisational system serving purposeful action supported by IT. Though not specifically targeted at cultural analysis, it supports some cultural aspects and has the advantage of

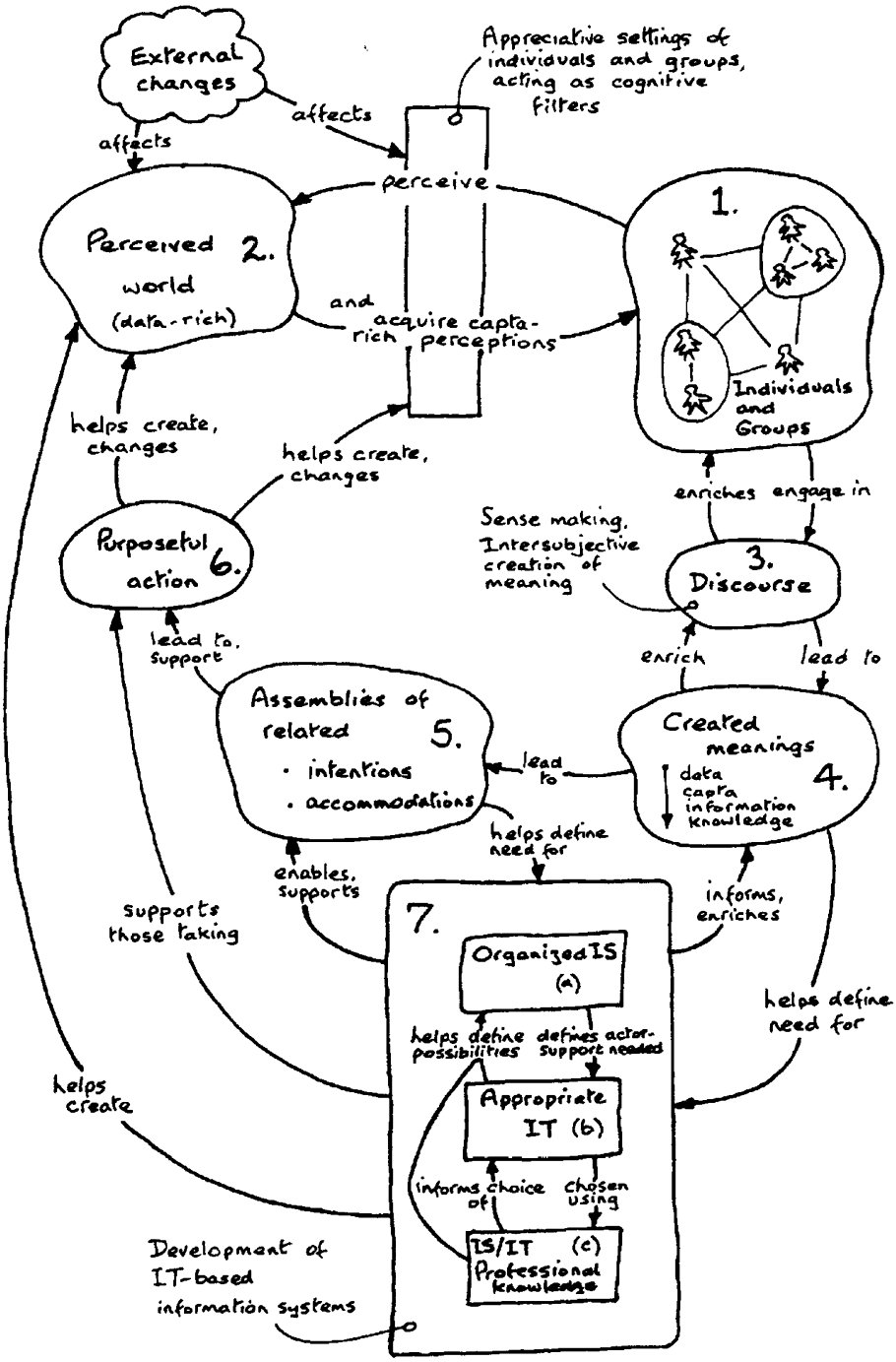

Fig. 1 Process of organizational meaning model (Checkland and Holwell 1998)

incorporating managerial and information system ideas, unlike many tools commonly used for organizational (Pettigrew 1979) or national (Hofstede and Bond 1984) cultural analysis.

Though SSM has been used widely for information systems development (ISD) and conceptualizing work systems (Kasimin and Yusoff 1996; Sorensen and Bochtis 2010), almost all studies have taken a single organization's work situation as their starting point, rather than a comparison.

The Interaction, Transformation, Interaction (ITI) Model

Though Checkland provides a rich account both of information systems in organisations, and organisational intervention organised as action research, he does not articulate the process of ISD, though other researchers investigate how it can be integrated with conventional ISD methods (Winter et al. 1995). For him, ISD is a natural sub-branch of managerial problem solving, whereas a traditional understanding of ISD involves specifying, programming and implementing a computer system into an organizational context. For an articulated ID process we turn to Rose (2002). Following Mathiassen and Nielsen (2000), he identifies two forms of soft system modelling, interaction modelling (Rose 2001) and transformation modelling. Interaction models focus on regularity—relatively stable relations between system components. In addition it is common to model interactions between humans and computer systems (in contrast to the Checkland tradition which focuses solely on human activity). Transformation models focus on change, the evolution of the state of a system through a series of processes, converting input to output. This enables ISD to be understood as an organised change between a (current) relatively stable series of purposeful human interactions, to a future situation in which improved interactions are supported by improved ICT (Fig. 2). An important component of the model is the development of socio-technical conceptualisations of a desirable future state of interactions, in which both purposeful human action (e.g. work processes) and IT are considered.

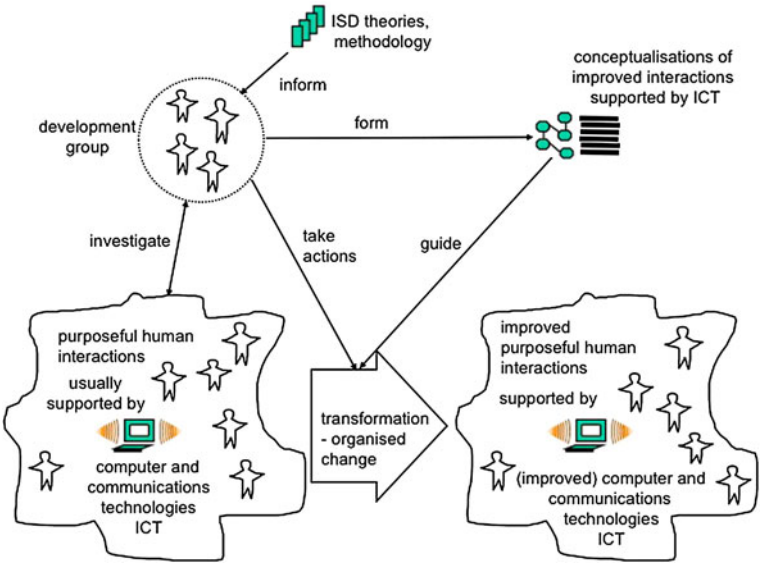

Fig. 2 The ITI (interaction–transformation–interaction) ISD model (Rose 2002)

The Research Strategy

Research Approach, Ontological Standpoint and Choice of SSM Adaptions

SSM is usually associated with action research, and ISD can also be researched through action research (Baskerville and Wood-Harper 1998; Baskerville 1999).Action research 'aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework' (Rapoport 1970). Its nature involves 'simultaneously bringing about change in the project situation (the action) while learning from the process of deriving the change (the research)' (Wilson 1984)—a dual imperative (McKay and Marshall 2001). It is a form of engaged scholarship (Van de Ven and Johnson 2006). The focus is on studying and solving 'complex immediate problematic situations and social-organizational problems' (Blum 1955). Thus action research, usually conducted through extensive field studies, is context specific—used for diagnosing a specific problem with intention to improve the situation with collaborative involvement of the stakeholders (Burns, 2000). It has earlier been used in cross-cultural studies (Chang et al. 2010). Acknowledged problems with action research include:

- goal dilemmas between the practical problems at hand and the research endeavour (Rapoport 1970),
- value dilemmas between roles as consultant and researcher, such as clients' belief in quick actions (quick wins) versus researchers' belief in careful abstract reflection before action (Rapoport 1970),
- difficulties establishing rigour and objectivity according to conventional positivist natural science traditions (Susman and Evered 1978),
- preoccupation with organizational problem solving at the expense of transferable theoretical understandings (Susman and Evered 1978),
- lack of epistemological clarity in theory testing and development (Rose 1997),
- difficulties with the management and control of action research projects (Avison et al. 2001).

There are many overlaps between action research and design science, which seeks to make the act of design methodologically justifiable as science (Hevner et al. 2004). However, where action research in the management field typically focuses on organizational analysis and improvement, design science concentrates on the defensible (in research terms) production of an IT artefact, typically a computerised information system. Since our research combines elements of both organizational improvement and system design, we adopt the specific paradigm of ADR (Sein et al. 2011). ADR 'reflects the premise that IT artefacts are ensembles shaped by the organizational context during development and use. The method conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artefact, intervening in the organization, and evaluating it concurrently' (Sein et al. 2011). Our research therefore builds on the seven principles of ADR:

1. practice-inspired research (problem-based knowledge creation at the intersection of technological and organisational domains, generalising to the class of problems that the specific problem exemplifies),
2. theory-ingrained artefact (using prior theories - in this case SSM - to structure the problem, identify solution possibilities and to guide design),
3. reciprocal shaping (recognising the mutual influences of IT artefact on organizational development and of organizational context on the design of the artefact),

4. mutually influential roles (stressing mutual learning through the interaction of practitioners contributing domain knowledge and practical design suggestions, and researchers contributing theoretical and technical knowledge),
5. authentic and concurrent evaluation (iterative evaluation of evolving design changes as they happened, expressed as organised feedback and the commitment to respond to it),
6. guided emergence (iterative design shaped by initial design suggestions, emerging interplay of technological and organisational factors, and responses to authentic and concurrent evaluation),
7. generalized outcomes (generalization of the outcomes of the research including generalization to a class of problems, generalization of the solution instance and/or derivation of design principles).

Whereas we use these seven principles to guide our overall approach to the research, the specific process and tools we use are adaptations of SSM. The main adaptations are:

- we integrate the ITI model to focus SSM on ISD and provide and overall process guide,
- we integrate the POM model as the primary vehicle for cultural analysis,
- we introduce a structured cultural comparison process,
- we integrate interaction and transformation modelling to provide conceptual modelling which can incorporate both organisational process modelling and IT systems modelling,
- we integrate specific tools for both organisation and computer system design where necessary, to enable more detailed design than SSM provides for.

Research Design

The form of SSM adopted is based upon Checkland's 1990 version. Mode 2 is employed, with conventional techniques (rich pictures, root definitions, primary task, conceptual models used as appropriate). In the logic stream they are supplemented by interaction and transformation models, to reinforce the overall ISD model adopted (see below) and other techniques designed to bring the work closer to the world of system and organisational development. These include flowcharts, graphical user interface sketches and prototypes, and physical models (Beyer and Holtzblatt 1998). The under-theorized studies of social and political system and the intervention itself (the cultural stream) are replaced with analysis structured by the POM model, preferred by Checkland and Holwell (1998) in his later work. The shape of the ISD work is governed by the ITI model; however it is framed as a comparison with the examination system at the Danish University (DKU) (Fig. 3). The comparison strategy is based on two assumptions:

1. examination information systems share considerable generic properties; that is, despite many surface differences, the underlying purposeful human activity is similar and can thus be meaningfully compared,
2. the examinations system at DKU, which is heavily supported by centralised IT, can act both as inspiration and warning (deterrent) for developments at the largely manual PKU department.

The comparison forms the underlying structure for a dialogue on sensible strategies and designs for improvements at PKU. The ADR was primarily carried out by the authors, (the PKU examinations officer and a Danish researcher), feeding into a wider discussion at the university, especially in the development committee, who also provide organized feedback for the ADR process. The development committee consisted of a group of nine, including

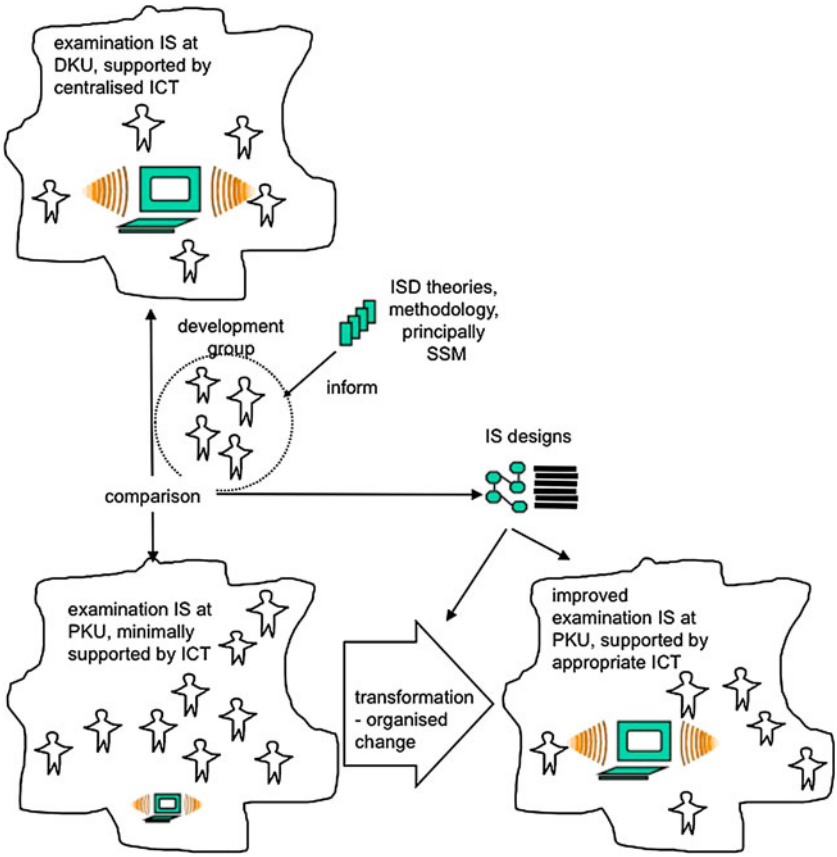

Fig. 3 Research design

the examinations officer, faculty members, an external software consultant, and one full-time and two-part-time software developers, chaired by the head of the university's computing department. Qualitative data was gathered from primary and secondary sources. A series of extensive field and on-site visits, semi-structured interviews, and face-to-face meetings were held with top management, middle management and operational staff of both organizations using the diary method. Interview lists and protocol are given in Appendix 1 and 2. Internal PKU stakeholders (operational staff, computer operators, clerks, officers of the examinations department, teachers, faculty members, students and other executive officers of the university) and external stakeholders (such as the HEC of Pakistan were consulted and their requirements studied. Other secondary data was collected from organizational websites, annual reports and official documents.

The seven principles of ADR are enacted in the following way:

1. practice-inspired research: the research is located in practice both at PKU and DKU,
2. theory-ingrained artefact: the development process reflects an extended version of SSM and the design artefacts use SSM (and other) modelling forms,
3. reciprocal shaping: the study investigates both organisational practice (human activity systems, cultural analysis) and computerised support and these are analysed and designed in relation to each other,

4. mutually influential roles: the research team is composed of both researchers and practitioners, with one of the members(examinations officer) working simultaneously as researcher and manager at PKU, and acting as liaison,
5. authentic and concurrent evaluation: interview reports were checked with interviewees for accuracy, SSM products developed iteratively though repeated contacts with development group, design suggestions were reported back to PKU for comment and improvement,
6. guided emergence: the study took place over six months with many iterations between researchers and practitioners and forms one of several inputs to the emerging organisation transition and system design,
7. generalised outcomes: the study generalizes major findings about design though cross-cultural comparison for use in similar research and practice situations.

Improving the Examination IS at PKU

The ADR project forms part of a wider exercise to modernise the examinations system at PKU. The development committee, constituted by the PKU vice-chancellor initiated a conventional systems development process with requirements gathering from the internal stakeholders. Users were invited to take part in discussions and brainstorming session, and their requirements were thoroughly discussed, designed on paper, and screen prototypes were developed by the software professionals in the group and then shown to them. This work was already underway when the opportunity to study DKU arose; the examinations officer spent a 4 months period in Denmark investigating examinations work at DKU. During this period he was trained in research work and the structured comparison process was developed and executed with the help of the Danish researcher involved. The examinations officer stayed in constant communication with the development group through online meetings, discussions, telephonic conversations and email/file transfer—ensuring concurrent evaluation of the work through their feedback. The eventual results of the study led to a series of proposals for changes to the PKU system (both the work systems and the supporting IT system under development). These were modified in discussion with stakeholders and the development group (now with the exanimations officer back in place in Pakistan) and submitted to the competent authorities for approval before being incorporated in the on-going development work.

Comparison of PKU and DKU: Current Situations

Initial work at PKU served to delineate the problem (Fig. 4) with the examination processing system: paper and ledger overload, case overload, many errors in printed certificates, much time-consuming face-to-face interaction with students, and long waits, causing stress and frustration amongst the responsible clerical staff.

Comparison of top level primary task (workflow) models for the two systems supports the assumption of generic similarity: primary tasks (taken to be conducting and assessing examinations, and communicating the results to students—Fig. 5) are very similar. However differences in implementation become very clear when a more detailed analysis is conducted.

Examination administration at PKU (Fig. 6) is centralised around a prominent independent organisational unit, and its principal means of communication is the flow of paper

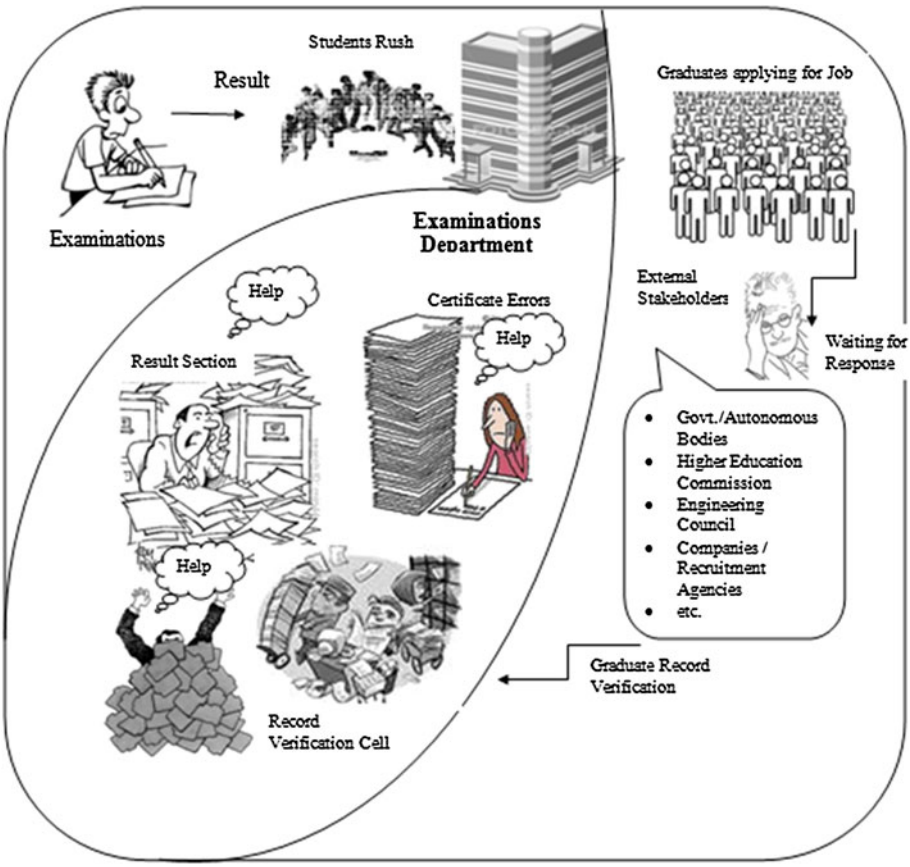

Fig. 4 Rich picture of problematic situation of PKU

documents around the university, supplemented by face-to-face interactions with students and staff.

Exam administration at DKU is decentralised in academic departments and based on a centralised computer system (STADS—Studie Administrative System) which is provided by the state (Fig. 7). Secretaries in the departments co-ordinate the work and enter data directly into the computer system without supervision. A small examinations office liaises between the centrally run database providers and empowered (but few) department secretaries.

Cultural Comparison of PKU and DKU Through POM Analysis

Although the examination information systems at PKU and DKU perform similar functions (purposeful action) there are many cultural differences to take into account. At PKU the examinations (the served system) are primarily written, with assessment and result delivery at a later time, whereas DKU retains an oral examination tradition where assessment and communication of result take place at the time of the examination.DKU works with a better IT infrastructure, more experience of computerisation and better computer literacy

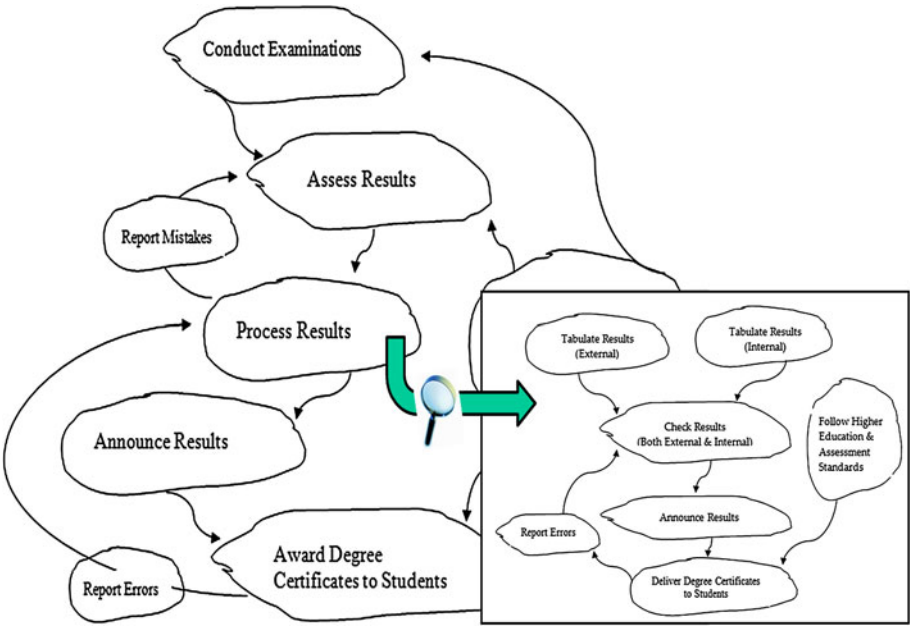

Fig. 5 Hierarchically decomposed primary task modelling (example): PKU

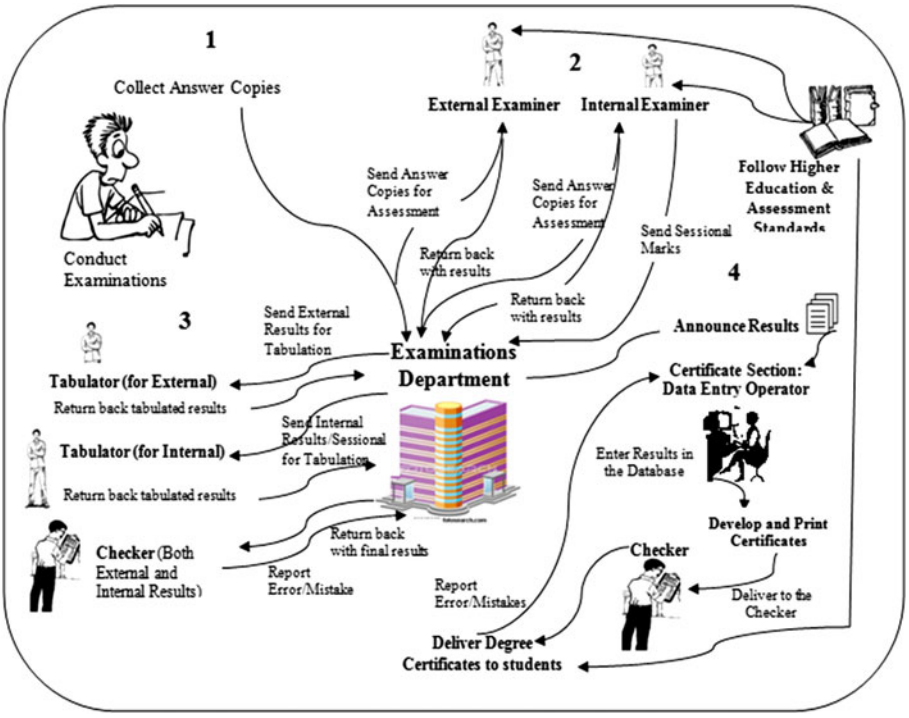

Fig. 6 Example interaction model: paper-based centralisation at PKU

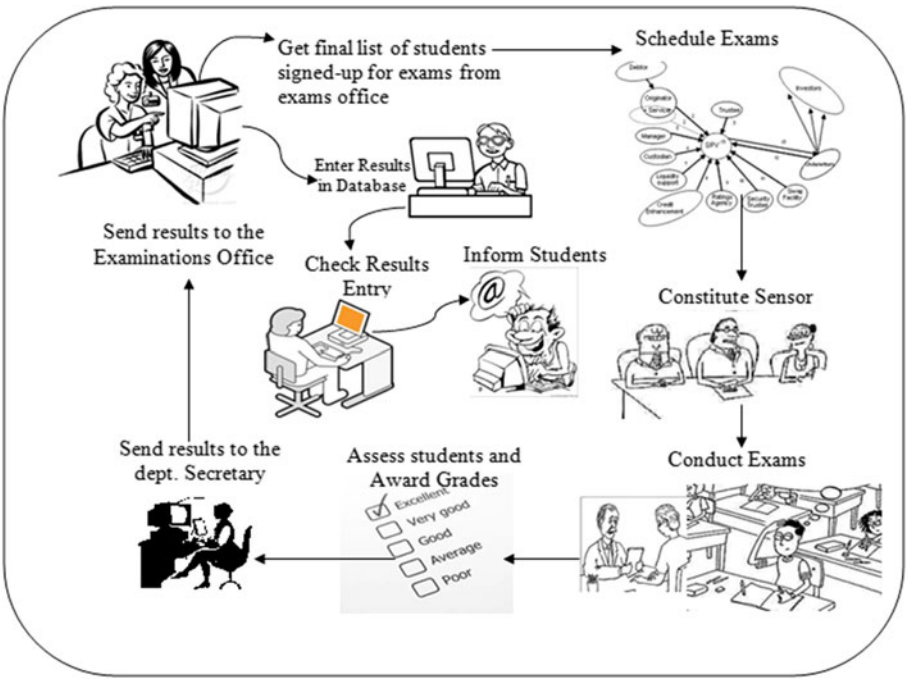

Fig. 7 Example interaction model: decentralised digital administration in a department

amongst all individuals and groups. A consequence of this is a shift in perceived legitimacy: whereas capta (those data thought important enough to be recorded and stored) are recorded on paper at PKU, digital capta (in a database, for example) are equally legitimate at DKU. Here the only paper-based legitimacy still required is the examiners' signature, and paper is actively discouraged with the slogan 'think before you print.' At PKU the determinate bureaucratic record is the ledger, at DKU the database (STADS). Communicative discourse is perceived similarly, important data are captured in memos and letters at PKU and in emails at DKU. Intentions for purposeful action are formalised at PKU as SOPs, with separation of responsibilities according to job description. Accommodations between individuals and groups are primarily resolved through the chain of command in a relatively strict hierarchical command structure. This can also have negative consequences; for example many trivial enquiries from students and staff are transmitted up the chain of command because service counter staff do not have the authority to answer them.DKU has few formal procedures, a minimal set of rules and regulations and a flat management structure. Empowered secretaries and administrators have localised practices evolved through tradition, with departmental secretaries perceived as administrative experts and many decisions taken communally. This means that problems and exceptions are more likely to be resolved by mutual accommodation through discourse, than by recourse to positional authority in the chain of command. At PKU confidence lies in hierarchical authority and ISO-certified processes, whereas at DKU confidence lies in the professional expertise of the administrators. The centralised computer system at DKU provides an administrative backbone or normative structure which removes some of the need for formal organisational procedure; some intentions and purposeful actions are embedded

directly into the computer system. For instance, the question of which data need to be stored as capta is largely resolved by the database forms which administrators and students are required to fill in on/line. It also provides some automation of the work process, for instance, automatic notification of results by email. Another feature is devolution of purposeful activity from administrators to students: they can register for exams, see their result profiles and print certificates without the intervention of administrators. A further cultural difference lies in transparency and openness. Access controls are built into the STADS (for example to ensure that students can only see their own records) but otherwise the DKU examination process is reasonably open, and staff, students and administrators share information on a need to know basis. At PKU there is a perceived need for confidentiality and secrecy, based on the assumption that the exam system is under constant threat of corruption and needs to be protected. This means that processes, apart from inputs (exam results) and outputs (exam certificates), are largely black-boxed and invisible to staff and students. Some processes are located in rooms which are physically secured and hard to get into, and full information is only available to the most senior officials.

These cultural differences are substantial, implying that design decisions for PKU which are based on direct copies of DKU's information system are not likely to be successful. Design should either reflect the underlying PKU culture and infrastructure, or take steps to change them which can be expensive and possibly painful. Moreover the apparently well-functioning DKU system has taken many problematic years to evolve, with some dissatisfaction amongst staff. An early version of the STADS database was reported as a fiasco in the media (Daarbak and Steinmark 2003). PKU's automation process may also be difficult because it primarily reflects the intentions of managers, rather than clerical workers.

A structured comparison process was adopted which involved isolating differences at DKU and PKU identified during the SM analyses. The DKU version was then considered for implementation at PKU, on the basis of whether it was systemically desirable (would contribute to efficiency operation of the exam system) and culturally feasible (could be implemented in the prevailing PKU culture and would fit in with broader considerations in the Pakistani educational system). The improvement possibilities were discussed in the development group and with influential internal stakeholders. The results of this analysis are shown in Table 1, which lists the major differences in examination administration at DKU and PKU

The Desired Future at PKU: Strategies and Actions

As a result of the comparison the research team developed a series of improvement strategies for PKU. The development team member responsible for investigating DKU and feeding the results into the development process returned to Pakistan to continue full-time with the development effort. Improvements were first articulated using the modelling language of SSM, then discussed with the development group responsible for decision-making and organising the improvement initiative. Figure 8, for example, represents a design for a future situation, where simplified primary task activities between major actors are expressed as an SSM interaction model, intended to stimulate discussion.

Figure 9 sketches a new organisation of data flows and user interactions with the proposed centralised database.

The major improvement strategies agreed by the development team were:

- a substantial information digitalization effort, covering student records, internal and external marks, sessional marks, result ledgers and result reports and the development of an integrated database system,

Table 1 Structured cultural comparison of PKU and DKU indicating implementation choices

DKU SSM elements	PKU SSM elements	Systematically desirable	Culturally feasible	Adopted	PKU strategy
Computer-based exams information system	Manual paper-based exams information system	Yes	Yes	Yes	Automation of examinations information through a centralised database to be developed
Flat management structure	Hierarchical management structure	No	No	No	Not desired
Service-oriented system	Formal procedure and rule based system	Yes	Yes	Yes	Rules to be amended through SOPs (standard operating procedures) to improve student service
Electronic record keeping	Manual record keeping	Yes	Yes	Yes	Manual paper records should be computerised
Simplified procedures	Complex procedures	Yes	Yes	Yes	Formal procedures to be relaxed due to implementation of electronic data processing system
Decentralized exam system	Centralised exams system	No	No	No	Not desired
Power and authority at lower level	Power and authority at middle and top management	Yes	No	No	Sharing of authority with operational staff perceived as causing problems in taking decisions. Should not be adopted
Strong ICT infrastructure	Weaker ICT infrastructure	Yes	Yes	Yes	Appropriate IT infrastructure should be developed
Information access to stakeholders	Limited access to information by relevant staff only	Yes	Yes	Yes	Internal and external stakeholders to be given access to the information through secure connection
Online self-service system	Personals visit to exam office	Yes	Yes	Yes	All relevant exam information to be provided at University web portal to minimize personal visits
On demand instant information access online	On request paper-based information provided on personal visit at exam office	Yes	Yes	Yes	Online user-based login system to be provided to the students, staff and faculty to access relevant information
Strong web portal management system	Weaker web portal management system	Yes	Yes	Yes	A specialised exam web portal with all exam related information to be developed
Strong coordination and E-communication	Isolated workplaces with communication gaps; manual with paper-based correspondence	Yes	Yes	Yes	Workplaces to be reorganised, fully equipped with communication devices and use of computer and internet network was encouraged

Table 1 continued

DKU SSM elements	PKU SSM elements	Systematically desirable	Culturally feasible	Adopted	PKU strategy
Strong ethical work practices	More security threats	Yes	Yes	Yes	IT use policy to be developed and user awareness developed
Flow of exam information at root level	Flow of exam information at middle management	Yes	Yes	Yes	Flat information flow accessible to all, ensuring transparency
Strong system integration	Isolated subsystems	Yes	Yes	Yes	All relevant exam activities and isolated subsystems to be integrated through centralised database software, and physical restructure
Strong communication between University and students, through web systems, and (increasingly) mobile solutions	Communication gap between University and students	Yes	Yes	Yes	Besides online web portal system, hotline/helpline cell and intercom and telephone call systems to be established to resolve students' cases, queries and issues. Mobile solutions to be investigated as most students have mobile phones
Paperless communication and official correspondence	Paper based communication and office correspondence	Yes	No	No	The sensitivity of the official correspondence, and secrecy issues requiring approval, do not allow complete removal of paper work
Use of OMR/OCR machines	Manual key punching for data entry/results entry	Yes	Yes	Yes	OMR and OCR machines should be deployed with exam database software
Online auto generate e-file certificates	Issuance of paper-based certificates on request	Yes	No	No	Paper-based verified certificates are accepted nationally. Not desired

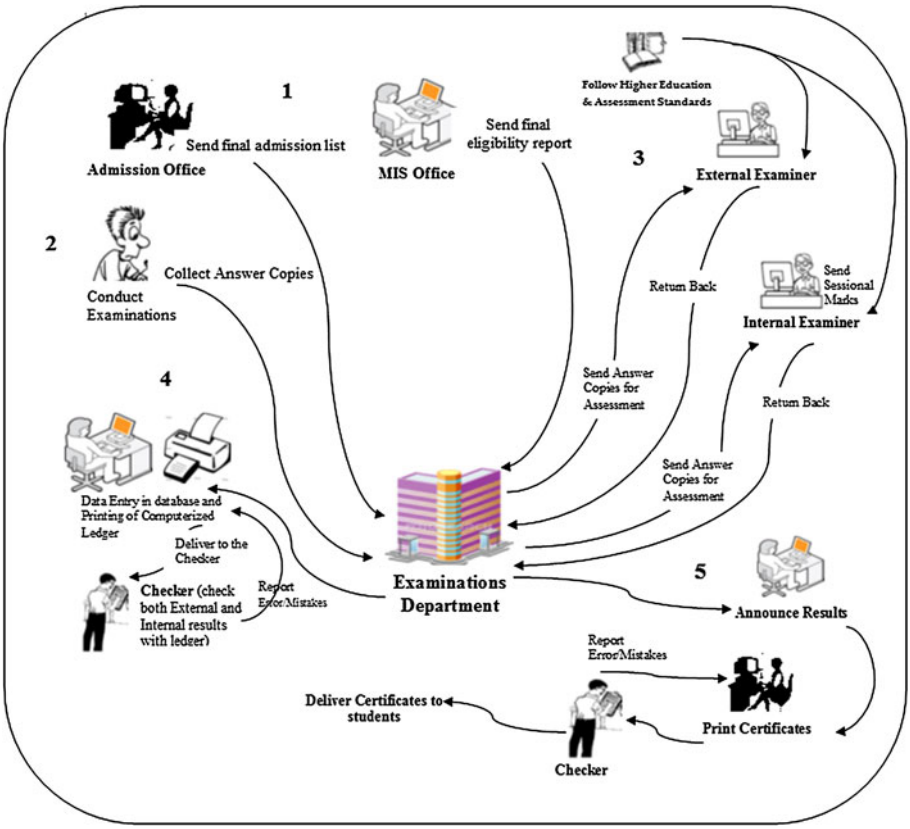

Fig. 8 Future (desired) simplified interactions for the examinations department of PKU

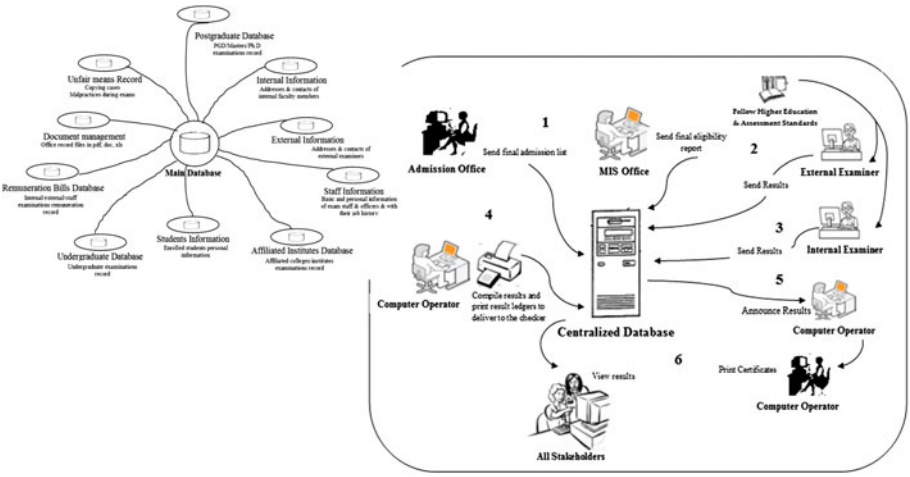

Fig. 9 Desired future: interactions with integrated database

- simplified interactions and procedures: all manual activities are replaced with computer interactions, except checking of both ledgers. Moreover two manual tabulators of internal and external results are removed. E-ledgers are printed from database,
- integration of the operations of the three sections of the examination office based on common database,
- an e-communication effort: student queries, inter-departmental correspondence, internal meeting calls and daily routine communications carried out by email,
- an investigation of mobile solutions for students without easy web access,
- reduction of paper-based information as a result of digitalization,
- web portal to act as the primary channel for delivering information (results, academic record, personal information, standard forms) to students and other external stakeholders,
- hotline/helpline to answer additional information queries,
- reduced student formalities (e.g. physical presentation of documents to prove identity) and automated fee payments with the purpose of reducing face-to-face interactions with students,
- identity control through unique log-in,
- automatic conversion of marks to international GPA (grade point average) system a),
- automation of input of grades through OMR (optical mark recognition),
- SMS information service for students,
- user friendly web application interface,
- physical re-organisation of the work-space.

These strategies comprise an ambitious digitalization effort, with the current paper-based administrative ledgers largely replaced by an integrated database, and some communications also digitalized. This implies a major cultural transition towards placing trust in digital records, and a small clerical staff reduction is envisaged. However, even here the capacity to create a paper record by printing an electronic ledger is retained. Other aspects of the PKU tradition are respected, for example the control and command management structure, the existing organisational structure and the perceived need for secrecy. Changes to the information system which potentially disrupt these cultural conditions are either considered inappropriate or likely to cause too much resistance.

Action to Improve the Situation

The ITI model suggests that the transition from the current relatively stable set of interactions to a future desired set of interactions be understood as an organised transformation: both information system (with supporting IT) and organisation the underlying human activity should change. The researchers developed a plan in the shape of an SSM conceptual model (Fig. 10) for consideration by the development group.

A technical study of the proposed system was initiated by the PKU software development team and user requirements gathered to feed into graphical user interface design. A relatively conventional systems development approach was adopted to support programming (left-hand side of Fig. 11).User participation was encouraged. Prior to the implementation of new systems, users were given IT-use awareness and system training. Computers were provided to clerical staff for office work, and their adoption encouraged by the introduction of a computer allowance. Network and internet infrastructures were improved, and email, chat and file-sharing software installed to encourage e-communication and reduce paperwork and printing. All staff were provided with personal email IDs and passwords at the University

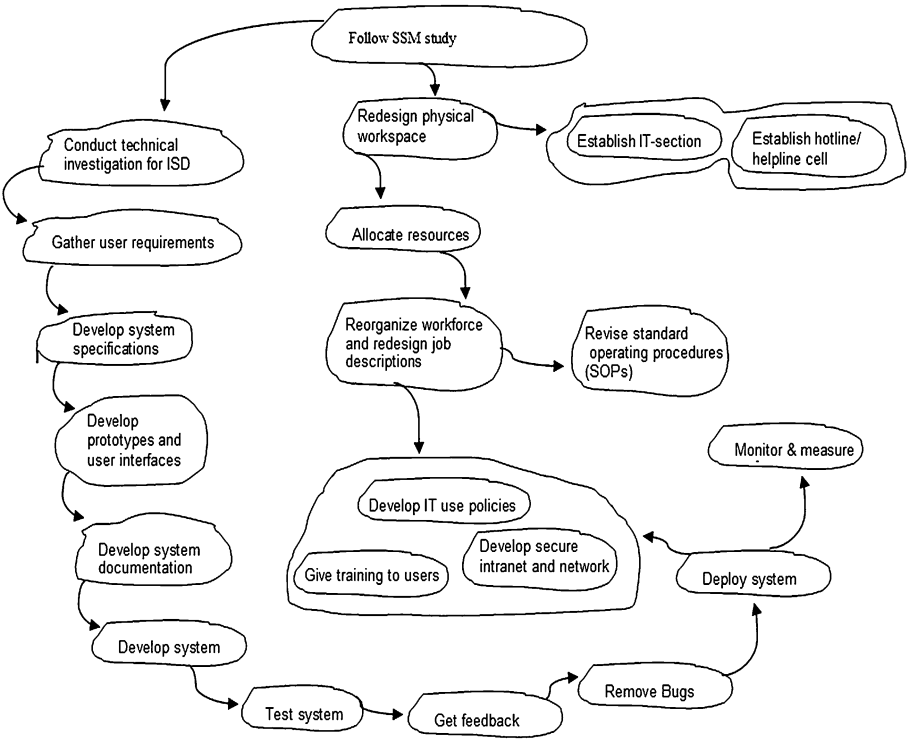

Fig. 10 Conceptual (transformation) model for achieving desired future for examinations department at PKU

domain. All examinations related information (news, announcements, results) and necessary forms and proforma were made available for students and teachers on a university website with a specific 'examinations' link. Meanwhile a separate interactive website for the examinations department was commissioned from the university's web developer. Feedback was encouraged throughout from staff and student through a specially designed proforma. A hotline cell was established in the examinations department to respond to informational queries of students, teachers, and external bodies. Additional PABX intercom points were provided to all relevant sections to strengthen internal coordination. Mobile service providers were contacted to develop an information and news network for students as a subscription service. Furthermore, SOPs were revised to remove formal paper-based procedures and hurdles faced by students. Job descriptions were also revisited. The central IT department of the university was given the task of developing IT-use policies and coordinating ICT infrastructure development in the examinations department.

Research Discussion

Cross-Cultural Comparison

The cross-cultural comparison is new in SSM ISD research and provides two primary learning points. The first is that the comparison exercise provides inspiration (through

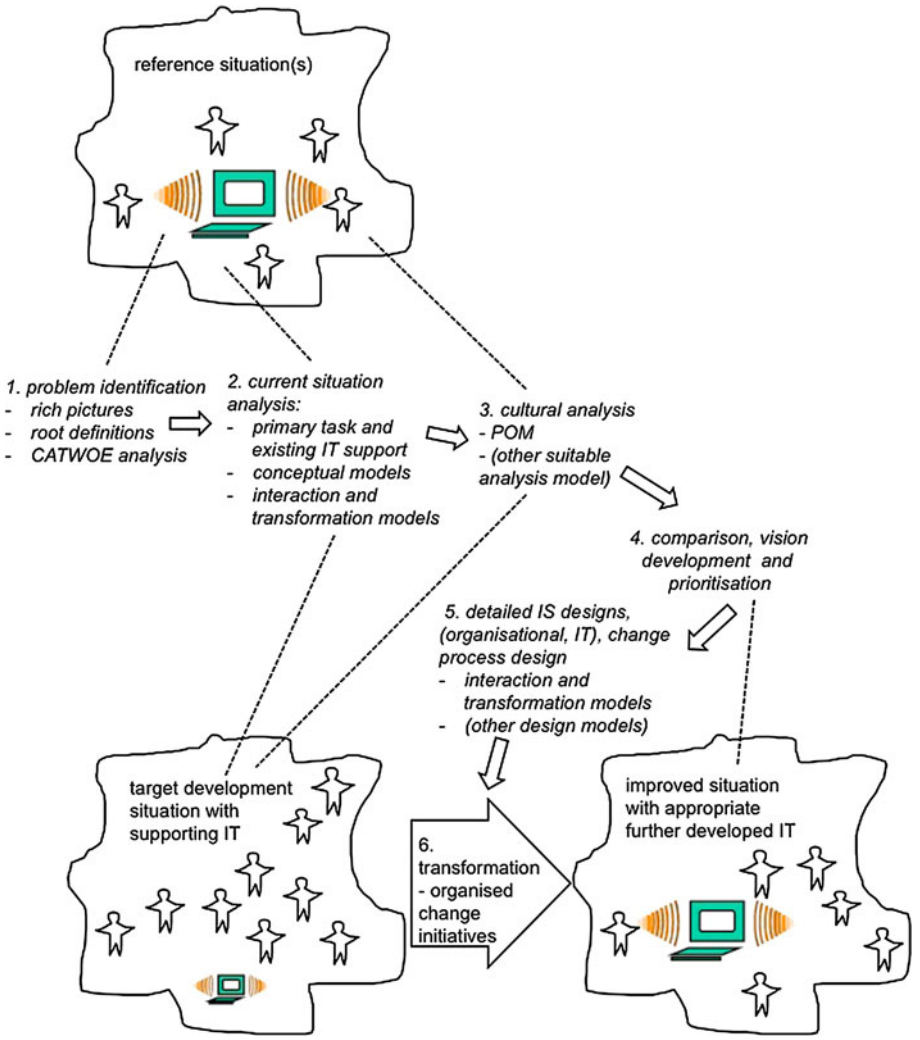

Fig. 11 Information system development through cross-cultural comparison: proposed process

examples of different practice) which is valuable in helping to move the existing mind-set (Weltanschauung) of actors in the situation. Users and managers can be quite conservative in their design choices, which are of necessity based on their own immediate experience, and this exercise is useful for opening up new choices and widening the sphere of possibilities. The second is that the comparison highlights cultural differences in the two workplaces which are important elements in the resulting design process. We believe that an explicit focus and a dedicated analysis strategy are necessary to expose these in this kind of project. An information system which is successful in one cultural situation is not necessarily a good model for another cultural situation, but it can be an excellent learning opportunity. Great care must be taken to assess which cultural factors in the work situation need to be challenged and developed in relation to the introduction of a new computer system, and which cultural factors should be protected.

The Theory Base: SSM in ISD

Two kinds of reflection on the SSM theory base are relevant; those which concern the underlying Checkland theorisation of information systems and ISD, and those which are methodological: how to improve information systems. In the first category we observe that Checkland's distinction between a served human activity system, and a serving information system (with accompanying IT) is difficult to apply analytically in our situation. At PKU the analysis should identify the (manual) primary tasks, and then help specify suitable IT to automate them. However the majority of the primary tasks are already information tasks: concerned with manipulating and disseminating examination information. There is no clear distinction between served primary task system and serving information system. At DKU, human activity system, information system and IT are fully integrated and have been for many years. Examining is a communication task (therefore primarily information) and some forms of examinations are automated and both administered and marked through a computer system. Here one can question whether it is advisable to distinguish between the purposeful human activity of management and its supporting information system, to privilege the management activity over the information activity, and to cast IT in a subordinate role. Embedded IT systems may be so central to the management process that they play a structurally defining role, as much as a supporting role. Management activity is shaped both by human intentions and accommodations, and by the affordances of the technology that they work with. This duality (information systems as both shaped by social systems and shaping them (Orlikowski 1992)) is, to some extent acknowledged in the POM model. In this situation the interaction modelling of Rose, which does not discriminate between human–human, human–computer and computer–computer interactions, or seek to distinguish an underlying (information-free) primary task, is possibly more helpful for both analysis and design activities. The management system is assumed to be an integrated ensemble (Orlikowski and Iacono 2001) or assemblage (Latour 1987) of human and non-human components.

A second reflection is that Checkland, in the POM model, portrays an accommodating, discourse-based organisation with socially-created and recreated meaning in which information plays an important part. This represents a reaction to traditional accounts of goal-seeking organisations in Checkland's thinking. This modern conception of organisation is easier to relate to the equal, trust-based and empowered Danish organisation, than to the primarily goal-driven, ISO-certified, hierarchically structured and process-driven Pakistani university.

A methodological observation is that the ITI model works better as a planning tool for action research than as a description of the empirical process. The account of an 'improved information system' articulated by the research team (working largely at Aalborg) and fed back into the development process is one of several influences on the development group, in an emergent continuum of competing design suggestions, decisions and actions to improve the situation over a period of several years. Furthermore, as noted in other contexts (Lewis 1994), SSM tools are not really detailed or logically precise enough for software design and both flowcharts (not shown) and user interface sketches were developed to support dialogue with the system developer. However SSM tools were not precise enough for organisational redesign either, and workplace models and process descriptions supplemented this side of the improvement effort. It should also be noted that this does not constitute a problem in the research—it was simple to incorporate other, more focused tools.

The ADR Process

Action design research has a focus on artefact design, which is also shared by our ITI model-driven SSM process. The artefact in this case is the examination information system at PKU, understood as integrated social process and IT system. In the cultural comparison situation, the SSM-based research process has several advantages, including easily transferable dialogue-facilitating tools, which allow comparison of both primary task and the principle interactions. The ITI model structures the design task, and the POM structures cultural comparison (to some extent).The advantage of POM in this context is that it integrates some cultural considerations with Checkland's understanding of an information system. However, the POM model is quite limited as a cultural analysis tool compared, for example, with Hofsteder's cultural dimensions (Hofstede and Bond 1984). It makes no explicit reference to power distribution, gender roles, individualism versus collectivism, uncertainty avoidance or decision-making horizons, or other culture-theoretical concepts. Either Checkland's model needs to be made more culture specific, or some information concepts need to be integrated into an accepted theory of culture before this process can be considered rigorous in research terms.

The ADR framework fits well with both the Checkland's understanding of action research and the ISD problem situation. The emergent aspects of ADR (for example guided emergence and concurrent (iterative) evaluation, match well with Checkland's use of SSM for structuring an on-going dialogue between researchers and practitioners. They also re-organise the classical design research challenge of implementing an information system and thereafter evaluating it; where demonstrating a causal link between the research and eventual outcomes is extremely hard to achieve. The emergent aspects of both Checkland's action research approach and ADR also match the emergent nature of ISD projects (for example the PKU project), which seldom in practice reflect the clear phase and activity division assumed by a previous generation of methodology designers. Nor do they usually arrive at a perfect paper design which can be implemented. However most action research approaches require a focus on real change in the situation (missing from ADR) which is often difficult to achieve (Borjesson and Mathiassen 2003). A focus on (emergent) organisational change might strengthen the ADR portfolio and give it a better balance between its design science and action research antecedents.

The Proposed Development Process

Figure 11 outlines a generalized version of the process, representing an rationalised version of the work we carried out, and incorporating some of our learning. Ideas from both conventional SSM and the ITI model are incorporated, centred on cultural analysis and comparison. Six stages are outlined:

- problem identification in the target (development) organisation,
- current situation analysis of both target and reference (comparison) organisation,
- cultural analysis,
- comparison and vision development,
- detailed design,
- transformation initiative.

The process is intended to serve as a guide for researchers and practitioners with similar projects and as a starting point for future research.

Conclusions

The present article articulates a strategy for learning about ISD in developing countries from experiences with similar systems in countries where administrative systems are heavily supported by IT. The learning strategy adopts neither a technology transfer paradigm (where the premise is that technologies from industrialised countries should be customised) nor a socially-embedded action paradigm (where the premise is that technologies should be built from the ground according to local conditions). Instead it learns from comparable experiences in developed countries whilst applying a cultural filter to inform design choices. The research question is thus: 'how can you develop a new information system through structured cross-cultural comparison?' There are potentially many answers to this question; however the approach proposed in this ADR uses an adapted version of SSM to structure the comparison. The adaption includes the ITI model (with interaction and transformation models) to guide the ISD effort and the POM model to guide the cultural comparison. Other tools are included as required to help with specific features of the development, and the result is generalised for use in similar development situations. The research is limited to a single longitudinal case study, making it difficult to generalize, but findings suggest that the comparison activity is beneficial to the development process in opening up the variety of design choices available, and stimulating unexpected, ambitious and creative solutions. However, lack of attention to cultural difference is likely to result in a technology transfer mentality and consequent design-actuality gaps as observed by Heeks (2002). Applying a cultural filter to design choices is thus important. Modifying SSM is a useful methodological approach, supplying an appropriate toolbox and structure, and the underlying conceptualisation of information system as socio-technical systems is appropriate, at least to this project. ADR is shown to be a suitable research approach for cross-cultural design through comparison. However Checkland's conceptualisations of organisation and information system are challenged by wide cultural diversity; unsurprisingly they are shown also to be bound to certain cultural conditions. Other cultural analysis models may prove to be more effective than the POM model. Future research will address these difficulties.

Appendix 1: Interview List

See Table 2

Table 1 List of interviewees in Pakistan and Denmark for problem and current situation analysis

PKU, Pakistan		
1	Ex-Controller of Examinations	Examinations affairs
2	Additional Controller of Examinations (conduct)	Examinations affairs
3	Ex-Deputy Controller of Examinations	Examinations affairs
4	Deputy Controller of Examinations	Examinations affairs
5	Assistant Controller of Examinations (computer section)	Examinations affairs
6	Assistant Controller Examinations (secret)	Examinations affairs

Table 1 continued

7	Examination Affairs Coordinator examinations in charge	Examinations affairs
8	Superintendent	Examinations affairs
9	Assistant/Inquiry Counter Examination Section	Examinations affairs
10	Assistant/Secret	Examinations affairs
11	Assistant/Conduct	Examinations affairs
12	Printing Machine Operator/Conduct	Examinations affairs
13	Faculty member	Examinations affairs
14	Faculty member	Examinations affairs
15	Department member	Examinations affairs
16	Department member	Examinations affairs
17	Computer operator	Examinations affairs
DKU, Denmark		
1	Head of Division/Exams office Humanities	Examinations management at faculty level
2	Senior Secretary/Computer Science Dept.	Examinations management at departmental level
3		Student admission record
4	IT Manager/IT Dept.	Technical issues
5	IT Manager/IT Dept.	Technical issues
6	Technical Manager/Technical Management	Technical issues
7	Department Secretary/communication	Examinations management at departmental level
8	IT Administrator	Technical issues
9	Development Consultant	Technical issues
10	Professor/Mathematical Science Dept.	Examinations and assessment
11	Senior Secretary/Study Administration	Technical issues and database handling
12	Associate Professor/Psychology Dept.	Examinations and assessment
13	Associate Professor/Computer Science Dept.	Examinations and assessment
14	STADS/Study Administration	Technical issues and database handling
15	AAU portal	Technical issues and database handling
16	Student Worker/Humanities Exams Office	Exams record entry
17	(Randomly)	STADS portal feedback
18	Study Administration	STADS portal feedback
19	IT-Staff Member, IT Department	Technical issues and database handling
20	Students (randomly)	Exams/STADS

Appendix 2: Interview Design

Target interviewees: faculty members, departmental secretaries, examinations offices staff/officials, students, IT-staff, STADS (study administration).

Nature of INTERVIEW: face-to-face

Data collection method: notes, observations, official documents and reports, diary method

Interview type: semi-structured

Method of appointment: emails, telephone, personal contacts, personal visits

Focal points:

- Conduct of examinations
- Procedure and policies
- Formal SOPs
- Powers and privileges
- Job description and role in examination related activities
- Work flow—examination related data and information flow
- Database handling and record keeping
- User level access/privileges
- Data backup and recovery plan
- Result processing and announcement
- Issuance of the certificates
- Appeals and error rectification
- Secrecy and confidentiality
- STADS role and architect

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