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ABSTRACT

This paper discusses the specific problems and issues involved in studying information technologies in Eastern Europe and the USSR in the more general context of cross-cultural information technology (IT) research. The results reported are based on eight years of research into international information technologies by the Mosaic Group at the University of Arizona. The problems of doing this kind of work, where field and empirical studies are often impractical, are examined. Four analytical techniques, supported by a computer-based research environment, are advanced as means to solve these problems.

1. INTRODUCTION

As the information technologies (IT) continue to spread throughout the world, learning how to study them, both on a macro and micro level, is becoming increasingly important. Cross-cultural research in IT can provide insights for businesses struggling to become or remain competitive, for governments grappling with geo-political and geo-economic shifts, and for IT researchers who are seeking to gain a deeper understanding by testing hypotheses in widely varying circumstances.

This paper is concerned with the example of one region of the world, Eastern Europe and the Soviet Union.[1] It is based on the experience of the Mosaic Group at the University of Arizona (see Goodman et al. 1990), which was created to study the use, production, and absorption of information technologies in Eastern Europe. Mosaic has aggressively pursued this aim since 1981, producing a large number of journal and conference papers, chapters in books, and other reports. In the process, we have developed specific analytical techniques and computer-based tools to facilitate cross-cultural research and have begun to test their applicability to other regions such as China and South America. While some of the problems of studying IT in these countries have arisen because of the country-specific conditions, others are characteristic of the more general problems of cross-cultural IT research. In this paper, we begin by reviewing some of the literature concerning cross-cultural research. We describe the specific problems of studying IT in Eastern Europe and then examine the more general techniques and tools we have developed.

2. OVERVIEW

A variety of empirical research methodologies, ranging from tightly controlled laboratory experiments to on-site case and field studies, have been used by numerous researchers to create the core MIS literature.[2] But how does the researcher proceed when there is little open literature to examine, or when most of the open literature is "trapped" behind a language barrier; when survey participants parrot the official line in order to avoid potential trouble; when the very concept of field and case studies is practically unknown; when a laboratory experiment would have to be approved by bureaucracies in governments known to prolong such decisions; and when notes, recordings, and photographs may be confiscated when departing from a country? These are just a few of the problems that a student of East European information technologies must face.

The general problem of cross-cultural research is one which has been addressed in several different literatures. In the social sciences literature, Lisle (1985), Ashford (1981), Wildavsky (1986), and Wagner and Wollmann (1986) all have provided some guidance as to the differences in research in different cultural environments. Wagner and Wollmann list the differences in policy style, administrative style, and their influences on policy research and consulting for nine American, West European, and Asian nations. Their framework and descriptions are sufficiently general that they could be valuable if extended to Eastern Europe, on the one hand, or to IT more generally, on the other.

In the management literature, a central issue is language and cultural distortion of results. Hofstede (1980) is particularly clear: observers from different cultures see things differently; language does affect thinking; culture is a "collective programming of the mind" which influences every aspect of personal and business life.[3] Other management studies discuss methodological problems. McDonald (1985) and Minzberg (1979) concur that international research of all kinds is riddled with narrow, anecdotal support (the term "exampling" is used). Berrien (1970) called this "safari research," in which research design and forethought are abandoned in favor of study of targets of opportunity. However, none of these authors provide practical advice on how to modify research methodologies for international research, aside from a call for less anecdotal and more planned studies. In Boddewyn (1976) and especially Tannenbaum et al. (1974), the difficulty of studying what may be prohibited is addressed, drawing research in Eastern Europe directly into the discussion.

As computerization becomes a global phenomenon, there is growing interest in doing cross-cultural studies. In a 1987 paper, Schermerhorn observes a reemergence of interest in Japanese and other East Asian cultures. In MIS, for example, recent work at the National University of Singapore (Ho, Raman and Watson 1989; and Lim, Raman and Wei 1990) and the University of Arizona (see George and Nunamaker [1988] and several other articles in the same volume) has concentrated on variance in GDSS usage between North American and Asian cultures. One can argue that many of the problems outlined in this paper apply also to the study of Japanese IT.

At present, the MIS literature provides little methodological guidance on doing international research. For example, the series by Hamilton and Chervany (1981) on the evaluation of information technologies, or Jarvenpaa, Dickson and DeSanctis (1985) on research methodology issues, make no mention of the special circumstances and difficulties in studying international environments. A review of five major MIS journals from the past ten years, and several database searches, found many articles on research methodology, but *no* research which substantially deals with questions of methodology in studying international environments.

It is tempting to suggest that the explanation for these lacunae in the MIS literature is that there are no methodological differences in cross-cultural studies, or that they are unimportant. This paper will show that, at least in the case of Eastern Europe, substantial methodological differences are made necessary by the difficulties involved in doing research in these countries. Otherwise, problems such as the influence of language and different cultural environments, the tendency towards "safari" research, and the problem of "closed doors" can invalidate the results.

3. PROBLEMS IN STUDYING EAST EUROPEAN IT

The difficulties in studying East European IT, in particular, and in doing cross-cultural studies more generally, can be divided into four categories:

- Finding reliable *literature*,

- Getting *access* to, finding, and working with the people involved,

- *Communications*, language and cultural mis-match problems, and

- Internal and external *biases*.

3.1 Literature

Although Eastern Europe has a sizable body of Informatics and Cybernetics literature, one would be hard pressed to prove this through the collections of Western libraries. There exists no comprehensive listing of the journals in this area; it is difficult to tell which ones are missing, and hard to guess contents from titles. For example, the main journal for networking research in the USSR is *Avtomatika i Telemekhanika (Automation and Telemechanics)*. Furthermore, subscriptions must start at the beginning of a yearly cycle, and back issues are impossible to obtain. Journals arrive in the US three to six months late. There are also entire series of works that are published in such small numbers (e.g., 150 or 200 copies) that they can be obtained only through personal contact with the author. Newspapers are harder to scan because the titles of articles rarely reflect their content.[4] It is only within the last year that institutes such as the International Center for Scientific Technical Information in Moscow have begun to make bibliographic databases available to the West and access is still extremely limited and expensive.

In the US there are only a few strong library collections on Eastern Europe. The Center for Research Libraries in Chicago, the Linda Hall Library in Kansas City, and the Soviet Branch Library of the Department of the Census' Center for International Research in Washington, DC maintain large collections, but they are the exceptions.[5] The Library of Congress is far behind in cataloging its large holdings of Soviet books. Ordering specific East European books is often impossible if they already have been published.

The Foreign Broadcast Information Service (FBIS) is a US Government funded organization which publishes translations of foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. While this source is invaluable, its contents are driven by requests from the government, which makes it selective rather than comprehensive. The contents depend on the training and knowledge of the person selecting the

materials, which, in the IT area, has varied considerably over the past few years. Other English-language sources include the BBC World Service and the Munich Red Archive of Radio Free Europe/Radio Liberty. Often, the only recourse is long hours in the reading rooms of the Lenin Library in Moscow. Even then, the lack of photocopy facilities, three and four hour waits for materials from the closed stacks, an unusual cataloging system, and occasional censorship by the librarians can thwart the researcher. Rules about things we take for granted – such as being able to bring a laptop computer into the library – can change from day to day.

If one is willing to subscribe to many journals and to diligently use the few bookstores in the West selling East European technical books, it *is* possible to maintain a good flow of literature about East European IT. However, a second problem arises: quality control. The "referee" process in Eastern Europe is substantially different from that in Western Europe and North America, and most of what has been published in the East European IT literature has already passed through the hands of a censor. The researcher must carefully filter what he or she reads through certain tests: Is the author in a position to know what he reports? Does the article contain the kinds of details which suggest that something has actually been implemented, rather than simply planned? Would the author have an incentive to deliberately mislead? In general, these authors rarely present any discussion whatsoever of their methodologies. Because it is not the custom for institutional affiliations to be used in publications in Eastern Europe, writing to the author for clarification is often impossible.

The problem of unreliable literature is now being acknowledged by the East Europeans. In a recent US-published work by Soviet authors Shmelev and Popov (1989), an entire chapter is dedicated to explaining the statistics used. Ironically, it sometimes turns out that we can get better overall access to the literature than can the East Europeans themselves.

3.2 Access

Finding and meeting people in Eastern Europe is difficult. Having read about a development at an Soviet institute, for instance, it may be impossible to call, for telephone directories are scarce and there is no practical directory assistance, even within the Soviet Union. Learning the address is equally hard. The next hurdle, especially in the USSR, is the Foreign Relations Department, which serves as the gatekeeper to arrange and approve all visits by foreigners. At one institute we learned that the Foreign Relations Department kept yearly notebooks of all foreign visitors and who they visited. Then a visitor who came ten years earlier could be "directed" back to the same person or group with whom he or she met before. Obviously the Foreign Relations Department carefully selects who meets

whom. Until recently, permission was needed from the Foreign Relations Department to entertain a foreigner at home.

Once meetings have been arranged, though, the quality of information may still be low. Many East Europeans are isolated themselves and are not in a position to give an objective evaluation of how their research compares to other research being done in their country, let alone in other countries. The pervasive presence of the Foreign Relations Department inhibits candid conversation, as does the lag of East behind West, which can be professionally embarrassing. Researchers who want to give copies of their works to their visitors may have no possibility to do so, because they cannot get permission to use the carefully guarded photocopying facilities and have few reprints available. At a recent scientific meeting, a very high ranking Soviet official proudly announced that he had just obtained a personal copy machine in his office. Such exceptions are still exceedingly rare.

Even well-sanctioned and well-supported exchange programs may result in little. As a case in point, in the mid-1970s, a portfolio of National Science Foundation and US State Department exchanges was set up with the Soviet Union as a result of the 1972 Nixon accords. These exchanges covered a number of disciplines, from information to bridge-building technologies. Although the exchanges had the full blessings of the US and Soviet governments, they failed to bring substantial benefits for several reasons. For one thing, US participants were often insufficiently briefed about existing conditions in the USSR, so that much time was spent on preliminaries. Soviet participants also had to move cautiously given the climate of secrecy and the public nature of the exchanges. The Soviet lag in IT meant that US participants in the area of software engineering for business applications seemed to have little to learn.[6] Even unprecedented access to people and data was not enough to ensure successful research.[7]

Once a personal contact has been made, sustaining it is also quite difficult. The average time for a letter to go from the US to the Soviet Union is about four to six weeks, and is about three weeks in the opposite direction. Telephoning is arduous, many institutions do not have access to telex, fax machines are rare, and electronic mail, although it exists between US and USSR, is only accessible by a select few within the USSR. Joint research is virtually impossible with such turn-around times for communications.

Sometimes research can come to a complete halt because of bureaucratic interference, either in the home country or in the country which is being studied. For instance, one project to efficiently upload the Moscow Novosti press releases, so that scholars could access them through worldwide computer networks, was held up as of February, 1990. The Coordinating Committee for Multilateral Export Controls (COCOM) would not permit the shipment

of an 8-bit Z80-based device to Novosti that would enable the agency to do this uploading much more efficiently, purely because the technology fell under the category of telecommunications. The National Science Foundation exchange programs mentioned previously are another example. The US State Department and the Soviet Foreign Ministry have sometimes played a tit-for-tat game on issuing visas for travel, on occasion eliminating long-planned and potentially fruitful research-related trips. Whether or not COCOM or the State Department are right in these cases is irrelevant; the point is that researchers are being impeded by forces totally out of their control.

To the great credit of all the East European countries, the situation has changed dramatically over the past two years. More and more East Europeans are shedding their public facade and are prepared to speak openly about anything they know, of course excluding classified information. Meetings may still be attended by the Foreign Relations Department, but now it is looking for ways to make hard currency. Some Soviets still stonewall, perhaps out of long habit, but many are saying and doing things with foreigners they would not have dreamed of two or three years ago.

3.3 Communications, Language and Culture

The languages and cultures of Eastern Europe also create impediments to research. We find that language can present several barriers to effective research.

When communicating in any second language, technical terms can be mis-translated or mis-understood. In some countries, technical terms are easily translated from one language to another because they share the same root sounds – they are cognates. In countries such as the Soviet Union and East Germany, this is sometimes not the case: printer, for example, is translated as *pechatayusheye ustroystvo*. It took an early member of the Mosaic Group almost a month to realize that the expression *matematiche-skoye obespecheniye* should be translated as "software." Even some cognates do not have the obvious meaning: *Aktual'no* is often mistranslated as actual, but it really means "pressing."

Some of the language problems are caused by a lack of good quality technical dictionaries. The vast majority of Soviet dictionaries in IT, for example, were created by professional translators who coined many terms for the words they found in Western glossaries, rather than finding out the true language equivalents of the terms.[8] It was not until 1987 that a Russian/English information technologies dictionary was published which had reasonable and realistic translations (Borkovskiy 1987).

Also, the researcher may have difficulty taking notes during a meeting, because the natural language in which to take notes differs from the language being used in the meeting.

Writing quick notes in a foreign language is quite difficult, and so later interpretation of the notes may be flawed. It is best to work in teams of two and trade off asking series of questions, to give each other time to catch up with notes.

Finally, the language in which a question is asked may bias the answer. Schermerhorn (1987) describes an experiment in which choice of language for a survey influenced results. He found that, even with painstaking attention to exact translation, there was statistically significant language-based variation. In reviewing tapes of interviews done by the Mosaic group, we have found that the interviewer can ask a much more precise question in his native language, but that the corresponding answer will suffer because the interviewee does not fully understand. However, if the question is asked in the foreign language, it may be the wrong question. It is important therefore to use open-ended questionnaires, where iteration is possible.

Culture and protocol can also create problems. When researchers from the United States arrive at an institute or business, they are often introduced to high-ranking officials or academicians. While this peer-level exchange can be illuminating in its own right, the IT researcher is more often interested in observing the workplace, seeing systems in use, or talking to knowledgeable workers. A promising site visit can end up as hours of introductions, overviews, translations, and polite conversations, edging out "real work." One wonders if this is deliberate obsfucation or misguided politeness.

In the West, one of the chief forums for exchanging scientific information is at conferences. At least in the USSR, there is less of a work ethic for conferences and less substantive dialogue takes place. The Soviets are used to reading prepared statements. Criticism, intellectual striving, and attempts to reach decisions occur more in private than in public. The infrastructure to support multiple sessions at conferences is often non-existent.

3.4 Biases

The researcher's own biases can cause distortion and misunderstandings. For example, in North America, a team of workmen laying transcontinental communications cable would normally have less than ten members.[9] In the Soviet Union, the same job would take more than twenty. The inattentive researcher might judge the Soviet crew inefficient. But there are crucial differences: in Siberia, at least for the time being, there are no McDonald's and there are no Holiday Inns. In many places in the USSR, Soviet crews must bring an entire support system with them. What works in the West may not have the same value in Eastern Europe. In an economy where capital is valuable and labor is not, many of the assumptions which underlie Western information technology research are false. Replacing typewriters with word processors is not

cost effective when the word processor cost is ten years' salary for a clerk.

Insufficient technical training of IT researchers can also be the source of misinterpretation and confusion. Because the opportunities to study on-site are few in number and limited in time, researchers in IT in Eastern Europe must be prepared to understand everything that they are seeing. There, managerial, operational, and technical issues are all very closely intertwined. A clear understanding of all three is required before any conclusions can be drawn. It is usually not possible to go back for clarification of technical questions and issues.

All of these biases relate to ignorance or failure to be sufficiently comprehensive. Another form of bias is deliberate distortion because of bigotry or ideology. Personal contacts are especially important to break down stereotypes and help the researcher to view the "researchee" as a human being, living in a complex set of circumstances, whose choices may be constrained in ways the researcher cannot imagine.

Many of these same problems, and undoubtedly some we have not considered, are present when doing IT research in other cultures and regions. There may be less literature in general, and no bibliographic databases in existence. Organizations such as FBIS have been oriented towards translating Soviet materials, so translations from other languages such as Japanese and Chinese are less available. Obtaining access and maintaining contacts may also be hindered by an underdeveloped infrastructure, by secretiveness, or by bureaucratic interference. Language, cultural, and bias problems all must be overcome.

4. ANALYSIS AND TECHNOLOGIES

Because of the absence of suitable methodological guidelines for this kind of research and because of the problems and deficiencies outlined above, the Mosaic Group has developed a series of analytical techniques, tools, and procedures in order to perform cross-cultural IT research.

4.1 Analytical Techniques

The analytical techniques which are outlined in this section are central to the research methodologies developed for East European IT research and helped to define the set of tools we built to facilitate their use. They address two goals: determining *what* information to collect, and determining *how* to interpret that information.

The first step was to ensure that we were not biased by ignorance. We had to make sure that our fundamental research technique forced us to be comprehensive in considering all important aspects of the problems we were studying. To this end we adopted the web model, deve-

loped and described by Rob Kling and his associates in the early 1980s (Kling and Scacchi 1982; Kling 1987).

4.1.1 The Web Model

The web model grew out of Graham Allison's work on the biases involved in using different levels of analysis (see, for example, Allison 1971). In Kling's formulation, it is necessary to examine not just the information system equipment, applications, and techniques, but the area encompassed by a set of larger boundaries around each information system: the influence of historical exigencies, the infrastructure which exists to support the system, the social relations of the participants, and the "superstructure" or other objects which exert some kind of influence over the object.

If an IT researcher studying Eastern Europe does not take into account all of these areas, he or she can quickly draw incorrect conclusions. For example, in one recent study, the author relies primarily on millions of instructions per second (MIPs) and year of first shipment to develop comparisons between the IBM 360 and 370 series, plug-compatible mainframes, and the East European Unified System computers, which functionally duplicated some of the IBM machines (Judy 1985). Soviet models typically are delivered with less main memory and fewer I/O channels than the maximum values used in the comparison, and they have slower and lower-capacity disks and unstable systems software, not to mention their poor reliability and the extremely poor performance of maintenance organizations. All of these parameters exert a decisive influence on the real performance of the machines. The author is aware of these differences, but does not factor them into the comparison, giving a more optimistic overall view of East European accomplishments than justified.

To explain *why* the Soviet computers are such, one turns to history, the infrastructure, and the superstructure. The decision to copy IBM was a direct result of earlier failures of the indigenous Soviet computing industry (see Rudins 1970; Davis and Goodman 1978). Part of the lack of success of these models is explained by the influence of the superstructure, or higher-level governmental bodies (McHenry and Goodman 1986). Soviet "clones" were so poor in part because the Ministry of Finance refused to allow the computing ministries to use gold in their products, even though gold was essential to duplicate critical timing parameters of the IBM originals. In addition, economic incentives worked against the production, at the infrastructure level, of lower-priced items such as peripherals or extra memory.

The web model helps to ensure that *all* of the important considerations are taken into account. Its use helps to mitigate the effects of the so-called "safari" research problem and to take into account the relevant differences in policy and administrative style in the countries under

77

study. The web model has been used for studies ranging in scope from analyses of specific technologies (Wolcott and Goodman 1988; McHenry 1990) to societies and technologies as a whole (McHenry 1985; Stapleton 1985; McHenry and Goodman 1986; Goodman 1987).

4.1.2   Parallel Forecasting

A second analytical technique is peculiar to studying those areas of the world which are experiencing a technological lag behind the most developed countries. In these cases it is sometimes possible to compensate for information gaps by looking at past experiences in the more developed countries. Using this technique can also help to ferret out statements about technology which just do not make sense given the known lines of development which have already been selected.

Again turning to the Soviet Unified System computers for an example, it was fairly predictable, given the extreme conservatism of the Soviet bureaucracy, that, having copied the IBM 360 series, the Soviets would go on to copy the IBM 370 series. The Soviets are aware of the entire IBM product line and have planned out which niches they will try to occupy in the future. This technique of evaluating past experiences to predict potential futures makes it possible to come to the conclusion that it is extremely unlikely that the Soviets would launch a new, indigenous line of mainframes, abandoning the large investment in the IBM line they have made.

This technique has its limitations. It is not a foregone conclusion that the Soviets will succeed in producing close copies of current IBM machines. In fact, they almost certainly will not do so in the near future, because they cannot produce the one- and four-megabit memory chips and other highly integrated circuits these systems require. Someone using this technique with the Japanese might have been surprised by the extent to which they incorporated innovations into their IBM plug-compatibles while still satisfying the basic goal of compatibility.

4.1.3   From the Small to the Large

A third analytical technique, reasoning from the small to the large, helps to compensate for the absence of direct information and provides an upward and downward check on the veracity of available information. This technique compares policy statements that are made by people in authority positions to the work which is actually going on at lower levels. For example, throughout the 1970s, the Soviets spoke in glowing terms of building OGAS, a nationwide system for the exchange of economic information. OGAS represented the ultimate goal of compensating for the absence of a market by providing channels through which the equivalent of perfect information could flow. Unfortunately Soviet computers of the time had

precious little capacity to spare for teleprocessing and the telecommunications lines were execrable. If one had stopped at the glowing reports, one would have made a serious analytical mistake. (See McHenry 1988 as an example of the use of this technique.)

Of course the only way that the technique of going from the small to the large becomes feasible is if a very large base of information is laid down. This often means that it is possible to cite dozens of references in order to draw a conclusion about a certain fact. Even here the particularities of the country under study are of critical importance. In the Soviet Union there is one central source for statistics, the State Committee on Statistics (formerly the Central Statistical Administration). If you see five different publications, all listing the same speed for a computer, you might be tempted to think you have enough independent confirmation to conclude that you do know its real speed. In many cases, you are just seeing data from the same primary source. Unfortunately the Soviets have a marked tendency not to cite such sources in their papers, and more generally their papers can be quite sloppy in this regard. In some cases it was necessary for them to hide their sources because they were talking about a software product that had been "adapted" from a Western antecedent.[10]

This raises the question of how to interpret Soviet sources more generally. Fortunately, almost every Soviet book is stamped with the number of copies published. One can generally conclude that books with a smaller publication run are more likely to carry hard facts and statistics, especially those that reflect negatively on the USSR, than are books with larger publication runs. Conference proceedings, which are often available only if one attends the conference, can sometimes contain gold mines of information. (See, for example, McHenry [1987], which makes significant use of one of these.) Now that *glasnost'* has appeared, it can be even harder to distinguish truthful sources and those which seek to distort. One does not know if a journal has switched over to *glasnost'* yet (or at what point it did), and to give credence to articles which should be considered with suspicion could be ruinous.

4.1.4   Critical Leverage Points

A fourth analytical technique which weaves its way through our research is to look for critical leverage points. Again, if you know that IBM Model 5150 personal computers (the "PC XT") on the Soviet black market cost anywhere from 30,000 to 60,000 Rubles (between ten and fifty years' wages), that only 31 percent of urban families have telephones, that there is still a fairly large percentage of electromechanical switches in the Soviet telephone system, and that line noise through the existing physical plant prevents high-speed data transfers on all but the best, most expensive leased lines, you are not likely to conclude that private citizens are making use of a lot of bulletin board systems. If you can find the critical leverage points in the

technology or in any other parts of the web, you can compensate for not being able to do more extensive field surveys and from the absence of some literature.

4.2 Technologies

The analytical techniques described above have a common thread which binds them together: information. It became clear that cross-cultural studies of IT, and particularly of IT in Eastern Europe, would require the acquisition, indexing, and organization of large amounts of information over a long period of time. To gather this information, the Mosaic Group began with a very wide net: asking Soviet emigres what to read, using US Government sources, browsing at the few large Soviet-oriented bookstores, taking out many subscriptions, and cultivating joint exchange agreements with East Europeans. These efforts soon resulted in a large flow of information, although many of the publications could be described as "low-grade ore"; very few good nuggets of information surrounded by much irrelevant text. We found that IT information from Eastern Europe is *highly* variable in its

- level of detail and amount of hard information presented in each publication;

- scope of problems discussed, ranging from local, single projects to nationwide surveys;

- degree to which accuracy can be trusted or verified; and

- degree of timeliness and relevance to current projects.

The combination of volume and variability led the authors to develop an information system specifically aimed at assisting research in East European IT. The system had to allow information from all types of sources to be stored, since our methodology encompasses any relevant information. It had to help us to make the necessary connections among disparate pieces of information in order to build up the whole picture on a given topic. It had to provide for long term storage, since one never knows when a newly obtained piece of the puzzle will suddenly make it possible to interpret the rest.

4.2.1 The AAIS

The Arizona Analyst Information System (AAIS) was designed to support the building and maintenance of a database which can serve as a collaborative analysis and decision making tool over the course of many long-term, related research projects. It was built with two strong emphases: capturing textual data and expertise, and providing flexible means of accessing it. Tools were created to facilitate all stages of the research cycle, from data selection and entry, incremental analysis, and flexible

querying capabilities, to production of papers including bibliography generation. An important goal of the AAIS was to enable the Mosaic Group to overcome the limitations inherent in using anecdotal evidence: evidence made up of small, disjoint, conflicting, variable pieces. To turn this stream of anecdotes, "factoids," commentary, and observation into respectable, supportable, significant research requires an information system with that specific design goal in mind. A mapping from the analytical techniques described above to the AAIS is in Table 1.[11]

The basic textual element stored in an AAIS database is an approximate 27-line paragraph called a "text atom." A text atom is a unit of information – a single fact, or set of related facts, a comment on a statement, an abstract, or some other block of information. Each atom is associated with a reference key generated from its bibliographic information. Text can be chosen from sources that would normally be used in the course of any research, such as books, journals, articles, conference proceedings, abstracts, interviews, and personal trip reports. Any textual information, including unformatted tables of numerical data, may be entered at any level of detail. This is typically "messy" data – small pieces of information from a variety of sources that are insignificant by themselves, but when combined with other pieces of data attain meaning. Piecing this data together is a significant part of doing IT research in Eastern Europe, not because this painstaking methodology is preferred, but because this is the only way in which data are available. A small text atom size was deliberately chosen to force users to index information at a high level of specificity.

The indexing structures permit many connections to be made between disparate facts. A typical query might combine several index types, such as the name of a country, "Hungary" for example, with a keyword, like "superminicomputers." Altogether, over twenty different types of indices are available for a single text atom (see Table 2.) The researcher can modify retrieved text atoms by changing indices or adding analysis of the text. When writing papers or doing other research, researchers can make use of the original text and these linked analyses and comments. The entered text is carefully selected, since the people entering data in AAIS databases are the researchers themselves, not typists or scanner operators. They use their own knowledge when adding information and give value to that knowledge beyond what a clerical worker can.

The AAIS specifically supports data-intensive research methodologies; the overriding attribute of East European IT research is that multiple, triangulating references are needed to make a point, support a comparison, reason a conclusion, or dig out an answer. For example, if you were studying the spread of minicomputers across Eastern Europe, you might ask the question, "what is the diffusion of Soviet minicomputers in Hungary?" A single query to the Mosaic AAIS database provides forty-four entries which specifically deal with Soviet minicomputers and

Table 1. Specific AAIS Support for Analytical Techniques

ANALYTICAL TECHNIQUE	AAIS TECHNOLOGY
The Web Model • *looking at all aspects of IT*	AAIS allows the user to information structure. It does not tie the user down to a particular schema, and allows any level of detail.
Forecasting from Gaps • *knowing what happened in the same situation before*	AAIS stores parallel sets of multiple languages, and lets the researcher keep track of multiple technologies at the same time.
Small to Large • *building up knowledge from little bits of data*	AAIS files and folders let the user go from individual bits of information to higher and higher levels of analysis, and navigate at whatever level is appropriate.
Critical Leverage Points • *using unrelated facts to make broad conclusions*	AAIS focuses on the text atom, and supports indexing atoms in over twenty different ways letting the user draw things together easily.

Table 2. Indices on Text Atoms in AAIS Databases

Bibliographic Specifics	Bibliographic General	Non-Bibliographic and Administrative	Advanced Indices
English Title Non-English Title Volume, Number Date Published Edition, Pages Page(s) of Reference	Publisher Author Name Editor Name Journal Name Place Published Copies	Where Stored Date Entered Who Entered	Folder Hierarchy Simple Keywords Country Info Organization Person Acronym

mention Hungary. In North America, a single Department of Commerce report might be sufficient to make a statement about the export of personal computers to Brazil. In Eastern Europe research, the same type of statement might require all forty-four references, filtered and tied together using the analytical techniques described above.

In traditional information research systems, it is difficult to find a single keyword which would describe a problem as complex as minicomputer diffusion. In the AAIS, there is a special construct called the file folder which was specifically set up to allow the grouping of text atoms which answer certain questions. These file folders are arranged hierarchically, so that questions at various different levels of aggregation can be answered. The file folders form a

controlled vocabulary which is associated with the text atoms, while some of the other indices do not have controlled vocabularies.

Inside of file folders, researchers can create high level analysis structures. By sending atoms into folders, the researcher provides a single high-level organization of his information. But once the folder itself is opened, the researcher can create an even stronger organization by grouping information in analysis "templates." For instance, a template might contain a slot for a computer's speed, which would be derived by the analyst using the text atoms "sent" to that file. The user would provide a value (or values) for speed, citing the specific atoms in that folder which support this fact.

4.2.2 Support in AAIS for Foreign IT

The AAIS has specific support for the study of foreign information technologies:

- Allows input and display of non-Latin character sets, with automatic transliteration of Russian-Cyrillic into Russian-Latin and *vice versa;*

- Stores English and non-English versions of important entities: titles of articles, books, journals, and volumes, organization names, and acronyms;

- Maintains information unique to East European sources, such as *tirazh* (number of copies);

- Contains a glossary for quick look-up of English/Russian and Russian/English translations; and

- Uses special Soviet-specific heuristics for identifying different names for the same organization.

This support has proven valuable in letting the Mosaic Group work in the most natural environment for them – a multi-lingual one. Rather than attempt to translate all data into English and lose information in the process, the original or transliterated text can be stored, retrieved, and manipulated. The AAIS database used by the Mosaic Group has stored data in Russian, Hungarian, Czechoslovakian, German, Bulgarian, Rumanian, French, and Italian. Having these texts, titles, and names linked to their English translations is a great help to researchers working in an unfamiliar language.

4.2.3 Results of Using AAIS

The AAIS is a multiuser system, making it possible to capture the work of over seventy people over the course of eight years, including undergraduates, Masters and Ph.D. students, and faculty members. With a subject area as big as East European IT, this large set of collaborating researchers is the only way to make sure that there is some semblance of comprehensiveness of the database. Researchers constantly make use of the byproducts of other researchers' work. It would be unusual in one of our papers, for example, if more than 70 percent of the references cited were added to the database by the author. The power of the indexing used in AAIS databases also makes the system very useful.[12] Of course, to build such a database requires making a long term commitment. As the value of the resource increases, it becomes more and more difficult to contemplate ever going back to the old way of doing research.

In the Mosaic Group, it is not unusual to list five or ten text atoms which support a particular statement. Our assertion is that *this level of support changes the fundamental character of our research – it is no longer anec-*

dotal. By bringing together enough anecdotal evidence, and using the analytical techniques, we can have confidence that we have weeded out irrelevant or incorrect information and that our analyses are trustworthy. The AAIS makes it possible to "repeat" the research in the sense that all of the evidence that was used to make a certain conclusion is still available in a means in which it can be reexamined, particularly in the light of new evidence.

5. DIRECTIONS FOR FURTHER RESEARCH

The atmosphere of openness in Eastern Europe has already begun to change the way we do IT research. We have had the opportunity to make more use of field research to augment traditional literature sources and to directly participate in important conferences on IT in Eastern Europe.[13] In the Spring of 1989, for example, the USSR Central Economics and Mathematics Institute invited a team of fifteen US academics, including MIS professors, a sociology professor, and two economics professors, to a series of conferences on the "informatization" of Soviet Society. This open self-examination, coupled with an invitation for Westerners to participate in the process, was an extraordinary and unprecedented opportunity. We were able to fill in holes in our understanding, make contacts, and learn about IT in ways which had never been possible before.

5.1 Empirical Validation

Researchers at the University of Arizona MIS Department are also studying the Mosaic Group to empirically determine which aspects of our research methodology are most valuable and successful. While there is no control group against which to track the Mosaic Group, we are working to provide strong metrics for experiments and research using our techniques. The Mosaic Group has been self-validating; it has built up sufficient small instances and examples to provide a supportable statement about its own success. However, external validation of these assertions is very desirable and comprises several active research projects: Chen (1990; see also Chen et al. 1990) discusses the misconceptions that AAIS users have when indexing information and provides some suggestions for alleviating these problems. Roche (1990) is investigating the behavior of Mosaic analysts using the AAIS under conditions of information deprivation and uncertainty.

5.2 The CARAT Project

The Mosaic Group has also started development of the Computer Assisted Research and Analysis Tool (CARAT). CARAT is designed as a next-generation collaborative research system to replace the AAIS. Incorporating all of the features of the AAIS, CARAT will provide greater power to the researcher in several ways:

1. By letting users define new information structures "on the fly" to suit their view of the topic currently under study. Typically these structures will be of a complex nature and the information in them will be derived from secondary analysis of text.

2. By extending the idea of "data" from Latin and Cyrillic text to any international alphabet, graphics, tables, photographs, and other visual representations of information.

3. By building a more seamless research environment for groups of researchers working on long-term projects.

4. By moving from character-cell displays to bitmap displays and making strategic use of the new graphical user interfaces technologies.

5. By providing enhanced support for automatic and semi-automatic indexing of information, and by helping the researcher build index thesauri to keep variability of indices down.

The complex structures mentioned in (1) are an extension of the idea of building templates in the analysis files. These new objects will be user-defined. Links with other objects and direct processing on the objects will be possible, increasing the range of connections that can be made among various parts of the web. Multimedia objects in area (2) will also extend the ability of the system to support the web model. Areas (3) and (4) should decrease the learning curve and allow each user to make better use of all the features. Currently in order to make full use of the query features in AAIS, the user must learn a complex database query language. Area (5) should help to manage the growing size of the indices, which is making it harder and harder for users to index new information, and should also address the problem of the increasing amounts of time users must spend to make entries at a time when the amount of available information is expanding greatly. The initial version of CARAT is expected to come on-line in late 1990 (see Snyder 1990).

6. CONCLUSIONS

Comparatively little has been published about doing cross-cultural IT research. There are specific problems associated with studying each region and culture, and problems which are invariably present. We have identified four analytical techniques that work especially well in the study of East European information technologies. Using the web model of computing, forecasting from technology gaps, reasoning from the small to the large, and identifying critical leverage points are all valuable techniques, and are clearly applicable to other IT research as well.

The AAIS is described as a system to support the study of IT in foreign countries. Its guiding principles were to capture any relevant information and expertise and to provide powerful ways of accessing this information. It can be useful for studies ranging in scope from narrow technology assessments to analyses of the state of IT in a region as a whole. Our study, and current external review, show that the AAIS works well in this environment. These studies are informing the design of CARAT, the next-generation collaborative research system that will replace the AAIS.

8. REFERENCES

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9. ENDNOTES

1. In this paper, Eastern Europe is taken to include Hungary, Poland, East Germany, Czechoslovakia, Romania, and Bulgaria. Although the USSR is not usually included in this term, we do so in this paper to simplify the terminology. When examples are taken from studying the USSR, this is explicitly indicated. Obviously the conditions described may not apply in equal measure to all of these countries, especially in light of the recent dramatic changes.

2. There are many possible citations; a recent article by Alavi, Carlson, and Brooke (1989) provides a summary as well as categorizations of 369 empirical and 423 non-empirical articles over the period 1968 to 1988.

3. The interested reader is directed to other works by Hofstede (1984; 1985).

4. Examples are myriad. In the October 20, 1986, *Pravda* article, "We Develop from Practice," by A. Tikhonov, the title gives no clue that the article is about the problems which have been encountered in the USSR hardware and software industries and the hopes being placed on a new organization to help solve them.

5. Private communication with Marianna Choldin, February, 1990.

6. Private communication with Benn Konsynski, 1990.

7. As Soviet tanks rolled into Afghanistan a few years later, the entire program was canceled, but for political and not academic reasons.

8. Ironically, one of the internal US government glossaries created on this subject was flawed by retranslating all the incorrect Soviet terms.

9. Private communication with representatives of US West, February, 1990.

10. Because of the absence of copyright protection for software in the USSR, it is incorrect to call this piracy, since it is not illegal.

11. The AAIS is described in several papers, including McHenry, Lynch and Goodman (1988), Carmel, McHenry and Cohen (1989), Lynch (1989), Masland and Snyder (1989), and Lynch et al. (1990).

12. See McHenry, Lynch and Goodman (1988) for a discussion of cross-researcher citation in the Mosaic Group. Masland and Snyder (1989) provide a discussion on the indexing and its effects on precision and recall.

13. This paper itself is a good example. Three years ago we would not have considered describing what we do in such detail for fear of putting our East European sources in a compromising position.