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contents

VOLUME I

Hans Kamermans
Kelly Fennema — Preface

Data Management

Jens Andresen
Torsten Madsen — IDEA – the Integrated Database for Excavation Analysis *3*

Peter Hinge — The Other Computer Interface *15*

Thanasis Hadzilacos
Polyxeni Myladie Stoumbou — Conceptual Data Modelling for Prehistoric Excavation Documentation *21*

E. Agresti
A. Maggiolo-Schettini
R. Saccoccio
M. Pierobon
R. Pierobon-Benoit — Handling Excavation Maps in SYSAND *31*

Alaine Lamprell
Anthea Salisbury
Alan Chalmers
Simon Stoddart — An Integrated Information System for Archaeological Evidence *37*

Jon Holmen
Espen Uleberg — The National Documentation Project of Norway – the Archaeological sub-project *43*

Irina Oberländer-Târnoveanu — Statistical view of the Archaeological Sites Database *47*

Nigel D. Clubb
Neil A.R. Lang — A Strategic Appraisal of Information Systems for Archaeology and Architecture in England – Past, Present and Future *51*

Nigel D. Clubb
Neil A.R. Lang — Learning from the achievements of Information Systems – the role of the Post-Implementation Review in medium to large scale systems *73*

Neil Beagrie — Excavations and Archives: Alternative Aspects of Cultural Resource Management *81*

Mark Bell
Nicola King — The MARS Project – an interface with England's past *87*

Archaeometry

M.J. Baxter, H.E.M. Cool, M.P. Heyworth — Detecting Unusual Multivariate Data: An Archaeometric Example *95*

Jon Bradley, Mike Fletcher — Extraction and visualisation of information from ground penetrating radar surveys *103*

Gayle T. Allum, Robert G. Aykroyd, John G.B. Haigh — Restoration of magnetometry data using inverse-data methods *111*

W. Neubauer, P. Melichar, A. Eder-Hinterleitner — Collection, visualization and simulation of magnetic prospection data *121*

A. Eder-Hinterleitner, W. Neubauer, P. Melichar — Reconstruction of archaeological structures using magnetic prospection *131*

Phil Perkins — An image processing technique for the suppression of traces of modern agricultural activity in aerial photographs *139*

Statistics and Classification

Clive Orton — Markov models for museums *149*

Juan A. Barceló — Heuristic classification and fuzzy sets. New tools for archaeological typologies *155*

Kris Lockyear — Dmax based cluster analysis and the supply of coinage to Iron Age Dacia *165*

Christian C. Beardah, Mike J. Baxter — MATLAB Routines for Kernel Density Estimation and the Graphical Representation of Archaeological Data *179*

John W.M. Peterson — A computer model of Roman landscape in South Limburg *185*

Sabine Reinhold — Time versus Ritual – Typological Structures and Mortuary Practices in Late Bronze/Early Iron Age Cemeteries of North-East Caucasia ('Koban Culture') *195*

Leonardo García Sanjuán, Jesús Rodríguez López — Predicting the ritual? A suggested solution in archaeological forecasting through qualitative response models *203*

Johannes Müller — The use of correspondence analysis for different kinds of data categories: Domestic and ritual Globular Amphorae sites in Central Germany *217*

J. Steele, T.J. Sluckin, D.R. Denholm, C.S. Gamble — Simulating hunter-gatherer colonization of the Americas *223*

Paul M. Gibson — An Archaeofaunal Ageing Comparative Study into the Performance of Human Analysis Versus Hybrid Neural Network Analysis *229*

Peter Durham, Paul Lewis, Stephen J. Shennan — Image Processing Strategies for Artefact Classification *235*

Gijsbert R. Boekschoten, Dick Stapert — A new tool for spatial analysis: "Rings & Sectors plus Density Analysis and Trace lines" *241*

Susan Holstrom Loving — Estimating the age of stone artifacts using probabilities *251*

Oleg Missikoff — Application of an object-oriented approach to the formalization of qualitative (and quantitative) data *263*

VOLUME II

Geographic Information Systems I

David Wheatley — Between the lines: the role of GIS-based predictive modelling in the interpretation of extensive survey data *275*

Roger Martlew — The contribution of GIS to the study of landscape evolution in the Yorkshire Dales, UK *293*

Vincent Gaffney, Martijn van Leusen — Extending GIS Methods for Regional Archaeology: the Wroxeter Hinterland Project *297*

Trevor M. Harris, Gary R. Lock — Multi-dimensional GIS: exploratory approaches to spatial and temporal relationships within archaeological stratigraphy *307*

Philip Verhagen — The use of GIS as a tool for modelling ecological change and human occupation in the Middle Aguas Valley (S.E. Spain) *317*

Federica Massagrande — The Romans in southwestern Spain: total conquest or partial assimilation? Can GIS answer? *325*

Shen Eric Lim, Simon Stoddart, Andrew Harrison, Alan Chalmers — Recent examples of geographical analysis of archaeological evidence from central Italy *331*

Vincent Gaffney, Krištof Oštir, Tomaž Podobnikar, Zoran Staničič — Satellite Imagery and GIS applications in Mediterranean Landscapes *337*

Yvette Bommeljé, Peter Doorn — The long and winding road: land routes in Aetolia (Greece) since Byzantine times *343*

Javier Baena Preysler, Concepción Blasco — Application of GIS to images and their processing: the Chiribiquete Mountains Project *353*

Geographic Information Systems II: The York Applications

Julian D. Richards — From Site to Landscape: multi-level GIS applications in archaeology *361*

Harold Mytum — Intrasite Patterning and the Temporal Dimension using GIS: the example of Kellington Churchyard *363*

A. Paul Miller — Digging deep: GIS in the city *369*

Julian D. Richards — Putting the site in its setting: GIS and the search for Anglo-Saxon settlements in Northumbria *379*

Jeffrey A. Chartrand — Archaeological Resource Visibility and GIS: A case study in Yorkshire *389*

Visualisation

John Wilcock — A description of the display software for Stafford Castle Visitor Centre, UK *405*

Christian Menard, Robert Sablatnig — Pictorial, Three-dimensional Acquisition of Archaeological Finds as Basis for an Automatic Classification *419*

Katalin T. Biró — Simple fun – Interactive computer demonstration program on the exhibition of the Szentgál-Tűzköveshegy prehistoric industrial area *433*

György Csáki, Ferenc Redö — Documentation and modelling of a Roman imperial villa in Central Italy *437*

Maurizio Forte, Antonella Guidazzoli — Archaeology, GIS and desktop virtual reality: the ARCTOS project *443*

Germà Wünsch, Elisabet Arasa, Marta Pérez — Dissecting the palimpsest: an easy computer-graphic approach to the stratigraphic sequence of Túnel VII site (Tierra del Fuego, Argentina) *457*

David Gilman Romano, Osama Tolba — Remote Sensing and GIS in the Study of Roman Centuriation in the Corinthia, Greece *461*

F.J. Baena, F. Quesada, M.C. Blasco — An application of GIS intra-site analysis to Museum Display *469*

Education and Publication

Robin B. Boast, Sam J. Lucy — Teaching with objects *479*

Martin Belcher Alan Chalmers Andrew Harrison Simon Stoddart	Teaching the Visualisation of Landscapes – Approaches in Computer based learning for Archaeologists *487*
Anja C. Wolle Stephen J. Shennan	A Tool for Multimedia Excavation Reports – a prototype *493*
G. Gyftodimos D. Rigopoulos M. Spiliopoulou	Exploring Archaeological Information through an Open Hypermedia System *501*
Martijn van Leusen Sara Champion Jonathan Lizee Thomas Plunkett	Toward a European Archaeological Heritage Web *511*
Mike Heyworth Seamus Ross Julian Richards	Internet archaeology: an international electronic journal for archaeology *521*
Virgil Mihailescu-Bîrliba Vasile Chirica	A Survey of the Development of Computer Applications in Romanian Archaeology *529*
Kris Lockyear	Computer-aided publication in practice *535*

Peter Hinge

The Other Computer Interface

1 Introduction

This paper discusses some of the conceptual problems that arise during the implementation of a Relational DataBase Management System (RDBMS). Specifically it focuses on the problems encountered during the implementation and use of the ORACLE RDBMS in a commercial archaeological unit; the Museum of London Archaeological Service (MoLAS) during a one year inter-specialist research project into the Roman London's Eastern Cemeteries (RLEC). The project involved 10 team members with various specialisms, and resulted in the creation of 67 tables, and 17 validation forms. On completion, some 40,000 rows of data have been recorded.

Yet it is not the structure of the RLEC database, the means by which it was interrogated, nor the various techniques developed to help elucidate patterns within the cemetery data sets that is of interest here. Rather it is the interface between the user and the *concept* of relational storage and manipulation that is considered, and how problems in that conception manifest themselves in poorly structured requests, that do not exploit the functionality of the RDBMS. More importantly, such conceptual problems can lead to disillusionment, as the advantage of the new system remains un-apparent, and old conceptual battle-lines between specialist data sets are simply re-drawn in the syntax of a newer technology.

2 Justification

The paper is then about problems, worse still it is about problems with an apparently mundane computing application. The benefits of RDBMSs, seem to be implicitly understood by a CAA audience, as indicated by its casual reference in the manner of a detail within the proceedings; i.e. 'attribute information is stored in an RDBMS while the graphical data is ....' Indeed, this paper also assumes some of that awareness, by not providing an introductory description of RDBMS architecture and mathematical set theory, or data modelling and normalisation.

However, this familiarity is both a bonus and a burden, with the latter becoming apparent during the implementation process when one is both engineer and evangelist. While bringing the good news of dynamic systems to a user group largely disenfranchised in the rounded interdisciplinary business of archaeological interpretation by inadequate IT, it is easy to forget how ignorant one was before one's own conversion. Users, who for years have dealt with cumbersome data systems offering rudimentary relational capabilities via cryptic procedural syntax, (e.g. most archaeologists at MoLAS) have a theory laden perception of data management which can remain unaffected by the word of Codd (Codd 1970) and the promises of their own computing section. The confounding effect of that perception must not be under-estimated, and is best addressed in an educative dialogue between designer and user. The broad promises of evangelists, must be demonstrated by practical little miracles among the familiar objects of archaeologist's lives.

3 Old Systems And Resident Experts

The conceptual legacies of previous systems, need to be understood and addressed. User-groups who have experienced a gradual implementation of data systems, carried out by various 'resident experts', at various points in time often enjoy an especially rich inheritance of this type. Within archaeology such patterns of implementation are perhaps more common than we would like to admit. The typically idiosyncratic style of systems devised in this manner is understandable, given that the resident expert is generally motivated to design systems to ease her work in her field. Equally the brief of such individuals, if there were one, is unlikely to have been to design for inter-specialist data compatibility, and all that that entails; *i.e.* agreeing referential standards, unique numbering schemes, accepted key-word lists etc. Less excusable, is for such individuals to remain the resident expert, and for the solution they devised not to be shared. The *resident-expert-and-the-bus* problem, (i.e. what would we do if X got ran over by one tomorrow?) is well known, but more subtle, is the question of levels of education and the existence of strategic motivation.

The 'expert' on his or her initiative has provided a solution for an archaeological need that has been inadequately defined. The brief is not for instance, to simply design a system that can record details of animal bones recovered from an excavation and a set of reports that will enable non-(Computing) specialists to print this data out. Rather it is to do these things, and to enhance further analysis through the use of the system, by *explaining* some of its functionality, and the potential it offers. This is not an argument to train further resident experts, for it is unnecessary for users to be able to design relational databases, it is simply to open their eyes and minds to the possibilities. To paraphrase the words of an anonymous sage, the biggest single need for a successful relational database implementation is not for improved recall speed, more rigorous input forms, congenial interfaces or prolonged memory, but for better questions and better use of answers.

The strategic question, is simply that a strategy must be made. A unit must have a policy regarding the utilisation of appropriate IT in general, and the adoption of rationalised systems to store and manipulate the data recovered from an excavation in particular. For archaeological units this is neither as obvious nor as glib a point as it may seem. In such situations the possibility to implement new systems in the manner of the standard System Development Life Cycle (SDLC) with all the steps that process implies (Hussain/Hussain 1991: 215) does not exist. The required time, staff and resources are often unavailable, to allow the necessarily exhaustive process of organising wide blanket development and education to take place. Rather, systems are developed in the manner of prototypes.

> 'A prototype is a tentative system, a model based on the interaction between analysts and users,.. *(it)* works best for systems that are highly interactive, (have significant human-machine dialogue), and is particularly useful when end users have difficulty specifying their information needs. Typical ad hoc decision support systems meets these requirements. Prototyping is also useful when problems to be solved are unstructured.' (My italics)
>
> Hussain/Hussain 1991: 222.

A prototype system has the advantages of speed of development, and thus cost, it enhances end-user participation in systems development, practically acts as a conversation piece, and often generates a more accurate determination of user requirements. The fact that in archaeological units such prototypes often evolve into the information systems themselves, and therefore that the strict developmental process defined as 'protoyping' is a misnomer, is not a problem in itself. Rather it simply continues the eclectic tradition by which archaeological theory and method has often developed. Yet such gradual modular development can easily mutate to resemble the idiosyncratic efforts of the past resident-expert-specialist, as each user group is focused on in turn. For small archaeological units, the need for firm strategies to be drawn up and monitored is of the utmost importance, for the very reason that the realisation of those strategies will be a modular, incremental and probably project based process, and one unsuitable to the more rigorous developmental checks that a properly resourced SDLC approach would allow. Organisational as well as interpretative problems will arise if such protoyping is conducted outside a firm policy of implementation, sanctioned by management with the aim of providing a single integrated and rationalised relational system that delivers a communal benefit.

> '... the general lesson to be drawn from the relevant management literature is that technological change is likely to influence archaeological organisations and their structures, and the roles of archaeological professionals, very widely.'
>
> Cooper/Dinn 1995: 89.

4 Identifying Changing Needs

Properly implemented and supported, the RDBMS is then an agent of profound change in the conduct of single or multi-site/thematic archaeological enquiries carried out in commercial units for whom such technology is now truly accessible. Misjudging just how profound that change is, will at the very least render the technology impotent in the minds of many.

4.1 Shifting tasks

An appreciation of the degree of this change, is not aided by the classical route of systems analysis, and the stages it involves. Identifying users tasks for instance, allows the designer to characterise the overall purpose of an organisation by considering the components of which it is made. Fundamental questioning of the type What is the task, why is it necessary, what data is required for it, is the task duplicated elsewhere and so forth brings to light poor reasoning of the type *'because we've always done it'*, *'because I was told to'* or the infamous; *'I don't really know.'* The designer understands the individual's role as a component of a larger structure and builds systems to support and ease the data-based tasks those individuals perform. An architectural response is provided for understood business needs, yet how does such an approach fare when the architecture itself is changing the nature, purpose or value of the tasks it is attempting to classify?

For example a finds researcher will identify the pottery from a context, compile lists of the types present and assign a *terminus post-quem* to the assemblage. This list will be passed to the site supervisor who will use it to phase the relative sequence of site development that has been deduced on the basis of structural data. With relationally disciplined tables of find and site data, the task of that finds researcher can and should change. Functionally, the structure makes the conventional 'passing' of data between finds researcher and site supervisor as a single act obsolete. Rather, this occurs at the point and in the manner of the user's choosing, The nature of the intercourse between the two groups also changes as *any* data set they produce is able to use the relational structure in which they exist. For example with access to stratigraphic information, the finds researcher is able to identify residual or intrusive assemblages augmenting their list of tasks and adding value to their role in the whole interpretative process.

The design of systems to support decision making, must begin by understanding the current state of information processing, to identify its weaknesses and strengths. Knowledge of these past modes of organisation however, must not be allowed to inhibit the generation of fresh and innovative solutions and aids to that decision making process. This argument is enforced in the context of archaeological decision making for here necessarily *structured* systems must be designed to record, manipulate and simply cope with large yet notoriously incomplete data sets that are then used to inform us about an *unstructured* phenomena; the past. Our databases have to balance the need for structure and thus intelligibility of data, against the cyclical hermeneutic character of archaeological enquiry that gives that data meaning. Initiatives voiced for an objective post-processual recording methodology, (Hodder 1994) threaten an unworkable imbalance by overfavouring the latter.

4.2 Interfaces And Understanding

An equally adept means of diverting attention from the profundity of what one is doing when implementing a relational system, is to place too much emphasis on graphical user interfaces and more generally the means by which the system is operated and accessed. Clearly such devices are intrinsic components of a successful implementation. They provide the crucial defence against the accusations of systems disenfranchising the archaeologists as interpreter, by enabling them to interrogate their data without recourse to specialised knowledge.

For RDBMS the Structured Query Language (SQL) requires knowledge of simple fourth generation non-procedural English-like languages. WIMPS based data browsers however, can spare the user even that hardship, as queries are built up from pull down menus of acceptable terms, parameters added and results posted to the screen. The issue here, is that much of the system's potential as an analytical device is dependent on users *conceiving* appropriate questions for the new architecture, which may then be phrased through such congenial object based environments. This point is returned to below.

In summary the conceptual problems that need to be addressed if archaeologists are to realise the potential benefit to their analysis that an RDBMS offers, are subtle, prone to growth without the confines of a strategic plan, and are not dealt with simply by the provision of a cordial interface. Not discussed here, yet equally relevant to the perception of new systems, is the more chaotic world of human emotion and how this is best handled. In this world, such powerful analytical tools which enhance the power of the individual to conduct multi-variable analysis, may also appear to threaten specialist authority, weaken job-security and effect career development. If one is prototyping systems for various user groups, which one shall be chosen first, how will the others feel?; apprehension and scepticism can mingle freely with enthusiasm. (See Cooper/Dinn 1995 for further discussion of this topic).

5 Some Specific Problems

In the course of the RLEC project introduced earlier, there were three distinct conceptual problems encountered. These were characteristic of users in transition between the older systems described in paragraph four, and the Oracle system they were confronted with. They are now considered.

5.1 Inter Specialist Boundaries

In common with most archaeological units, MoLAS has various basic specialist divisions, environmental, finds and field. These divisions also have sub-divisions, e.g. animal bone analysis, human bone analysis, pottery, building material etc. The divisions correspond to various areas of expertise, and in the initial stages of a project, specialists work in relative isolation, identifying what has been excavated. The extension of these divisions into the interpretative phase, either as an active decision or as a result of inappropriate information technology, will inevitably deny the generation of more holistic interpretations.

Relational database systems enable various archaeological data to be inter-related so that ceramic information may for instance, be related to the stratigraphy to indicate the degree of residually or deposit disturbance within a site. This much is clear, yet it is a bland statement to simply point out the possibility of myriad data relations, and ignore the environment in which such potential is released.

The evolution of recording systems at MoLAS, is a history of balancing the need to record excavations as accurately as possible, (the archaeological incentive) yet as quickly as possible, (the commercial imperative). Non-hierarchical site recording, using various pro-forma context sheets, carried out by archaeologists who are responsible for defining, planning and recording their own contexts, were all in direct response to the requirements of the complex urban rescue environment (Spence 1993). At the interpretative stage, the structural site details would be analysed to provide a frame from which other data sets — once they were available — would be hung, in order to contextualise the structural account. Thus dating information would enable the relative sequence of structural development to be phased.

There are two points here. Firstly that rationalised recording systems are essential if excavations are to be efficiently completed, and secondly the way in which data sets have been related in the past is not *solely* dictated by the adequacies of the information system employed. Thus the use of new systems must be considered within the necessary confines of the interpretative environment. This is not to say that such systems should simply make current practices more efficient, on the contrary there are inevitable consequences for working practices when new systems are implemented. Rather the practical adequacy of each improvement, change and addition to existing empirical techniques must be thoroughly considered relative to the real world in which (in this case) London's commercial archaeology is carried out. A realist stance based on the notion of practical adequacy, (Sayer 1992) is most appropriate to the environment in which MoLAS works, and provides the first line of defence against the use of novel systems and applications on a 'because we could' basis (Huggett/Cooper 1991: 40).

However, in order to provide the right conditions for systems offering improved data relatability to yield innovative solutions, the nature of specialist boundaries, and specifically the means by which 'relatability' will be effected, must be considered. There are two main factors; the architectural and the human.

The purpose of RDB architecture, is to enable relatability between data sets. Therefore table design that enables this functionality through the mechanism of referential integrity is a prerequisite. If properly designed, the relatability of data sets in computing terms is not a problem.

For researchers to adapt to the technology in conceptual terms requires some re-assessment of the forms in which the findings of one specialist group are communicated to another. It is important to point out, that one is interested here in the transmission of database information; an activity that occurs in parallel with the discussions, arguments and debates that occur between the specialists themselves. In the RLEC project, two examples of such reassessment can be given.

Human osteological information on sex and age was determined from some 14 different bone traits, both metric and non-metric. All of these traits are valuable to the specialist, with a final statement of overall age and sex being the culmination of those observations abetted by a greater or lesser degree of intuition. It is this aggregate decision that is of interest to the team, thus fields for overall age and sex were added to the appropriate osteological tables, enabling other users direct access to appropriate data.

The 2512 small finds recovered from the sites, of themselves, yielded much valuable information to the specialist and some to the rest of the team. But their contribution to the team, was enhanced when finds were grouped into functional categories, (luxury items, items of personal adornment etc.) that were stored as numeric codes in the object index tables. An interpretative, hierarchical judgement was made that built on the specialists work, (i.e. the initial identification of the object) but which enabled that specialist data to relate to the other data sets in a new and possibly more comprehensible way.

5.2 The Spreadsheet Mentality

A more practical problem, the 'spreadsheet mentality' as it was christened, is characterised by a desire to see all data of interest in a single large table, and by the belief that in order to compare one's data with someone else's, an extra column has to be added to the table and the appropriate data imported. It indicates a belief that data has to be in the same place to be relatable, which is a conceptual legacy traceable to older storage devices, the typical format of familiar reports and published data tables. It is a problem because it indicates that the comparison of traits is perceived as a structural problem and data structures are things that are not easily altered, ergo the potential for any data set to freely interact with any other has not been realised ergo the relational functionality is not used, result: disenchanted users. In this situation, the designer must emphasise two key points; the breaking down of specialist barriers and the importance of retrieval technique.

Excavation is a subjective exercise, and the data it generates is inevitably dependent on the recording procedures employed, and the individual who implements them on site. Yet a good relational structure dictates subsequent interpretation of that theory dependent data as little as possible by storing it in its most disaggregated state, and providing the means by which an aggregated state (of which there will be many) may be reached. One consequence of this is that inter-specialist boundaries are not only unenforced, they cease to be relevant, as the information from the excavation is expressed in terms of common relatable units. Such boundaries are concepts that the database need only be aware of for administrative purposes, a function ably catered for by a systematic table naming conventions. The RDBMS then, by its very nature is not disposed to enforcing incompatibility.

The spreadsheet mentality can also be addressed by emphasising the technique by which data is retrieved from the RDBMS. The user may query the database, and at that point, and in the manner of their choosing, tables are related. Thus querying becomes a more dynamic and slightly different process. Instead of solely analysing a table of data printed by a standard report, users are compelled to expend some time analysing the very form of the table itself. If one is already thinking more systematically about what one really needs from the database, then it is easier to progress to the next stage where the analytical functionality of a system like Oracle is realised.

5.3 The Pile Of Paper Mentality

This is characterised by general requests for large runs of data with little or no filtering criteria, or grouping. One reason for this is the belief that the computer is hiding information and that a visual check is necessary, another is that analysis is perceived as something that occurs outside the computer. A third is the wholly conceptual one, of data simply needing to be seen in all its exhaustive detail for the researcher to 'get her head around it'. (It could reasonably be argued that this is partly a product of the first two).

The problem is similar to that discussed in the previous paragraph, i.e. the ability of the database to search, verify and summarise data is not realised. Yet it differs, in that it sends a clear signal that the message *access is analysis* has not yet been assimilated (an assimilation that does not take place solely by *providing access*, i.e. an easy to use GUI interface). The volume of data to which access is now possible, and the diminishing resources available to analyse that data, means that it is becoming impractical to approach such resources without some research objective in mind, however insignificant it may be. At a time when project budgets are demanding the most efficient working practices to enable some funds to still be available for the actual analysis of the carefully rescued data, the need to replace mechanisms such as high-lighter pens, hand calculators and visual scans with the targeted search criteria, statistical functions and group operators of the RDBMS itself, is clear.

6 Conclusion

The problems discussed are neither difficult to address, nor are their effects hard to identify; they are however, easy to ignore. If users are to benefit from RDBMS technology in the core area of their profession — the quality and thoroughness of archaeological interpretation — such conceptual problems must be overcome. A poor implementation is that which ignores its own consequences, and for commercial archaeology in the 1990's a proper understanding of the positive benefits that new systems provide, must be recognised for the crucial component of a successful implementation it is. The quality of archaeological interpretation from those working in the commercial sector depends on it.

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