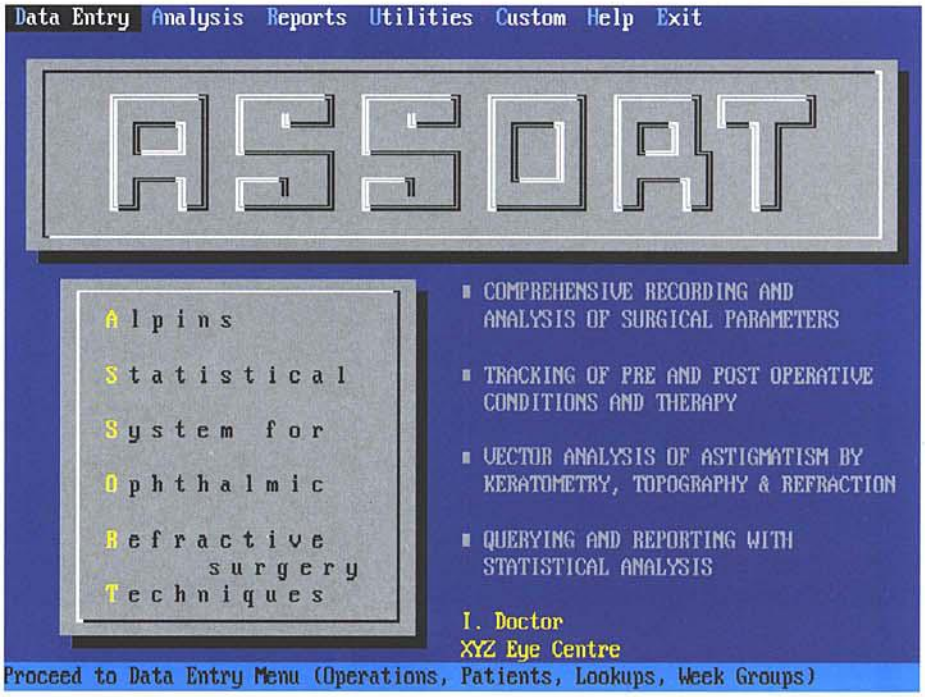
Top Paradox Programmer Wins Trip to US Conference

Melbourne-based Paradox expert and software developer John Carragher has won Borland's **1993 Paradox Challenge** with an innovative application custom-designed to assist opthalmic surgeons. After almost two years spent developing this project, Mr Carragher's prize — a trip to the Borland International Developers Conference in San Diego — will provide him with a well-earned break.

Created for a Melbourne-based opthalmic surgeon, the ASSORT application evolved through several iterations (including a rewrite from Paradox 3.5 to Paradox 4.0) before the final prize-winning version was completed. ASSORT was selected from the many impressive competition entries because of its uniqueness and unparalleled use of Paradox 4.0 features.



ASSORT Project Overview

In late 1991, the client began preparing for a presentation he was to give in the US some months later on the effectiveness of different stitching techniques on reducing astigmatism when performing eye surgery.

Dale Wickberg of Vantage Enterprises was handling the slide-making, and recognised the need to establish a database in order to cope with the amount of information available and to provide flexibility in the analysis of the data. Mr Wickberg was one of the original members of the Melbourne Paradox User Group, and this had led to an involvement with John Carragher of Norseman Systems on other projects.

The early version of ASSORT was based on a somewhat simple data model, but incorporated vector analysis of astigmatism and significance testing. The reason for building significance testing into ASSORT rather than to export data to a conventional statistical package was that most of the problems were in extracting data sets based on relatively complex specifications.

Once the client started getting results from the system, he seemed to develop an insatiable appetite for more ways of extracting and analysing his data. Hypotheses which he had proposed years before were finally able to be evaluated subjectively, and other ideas tested. He was aware at the outset of the need for an analysis tool for ophthalmologists and had plans to provide such a tool. The effectiveness of the system developed for his own requirements encouraged him to commit the time and money to making ASSORT available as commercial product.

Although vector analysis of the results of a single operation at pre- and post-operative visits proved useful, the commonly-used vector calculation values could not be employed to determine the effectiveness of different operative techniques. Considerable time was spent determining new measures which could be averaged and otherwise analysed.

The system was rewritten using a four-tier hierarchy (patient, operation, review visit, review visit details), which better suited the data but required more programming than the original two-tier model.

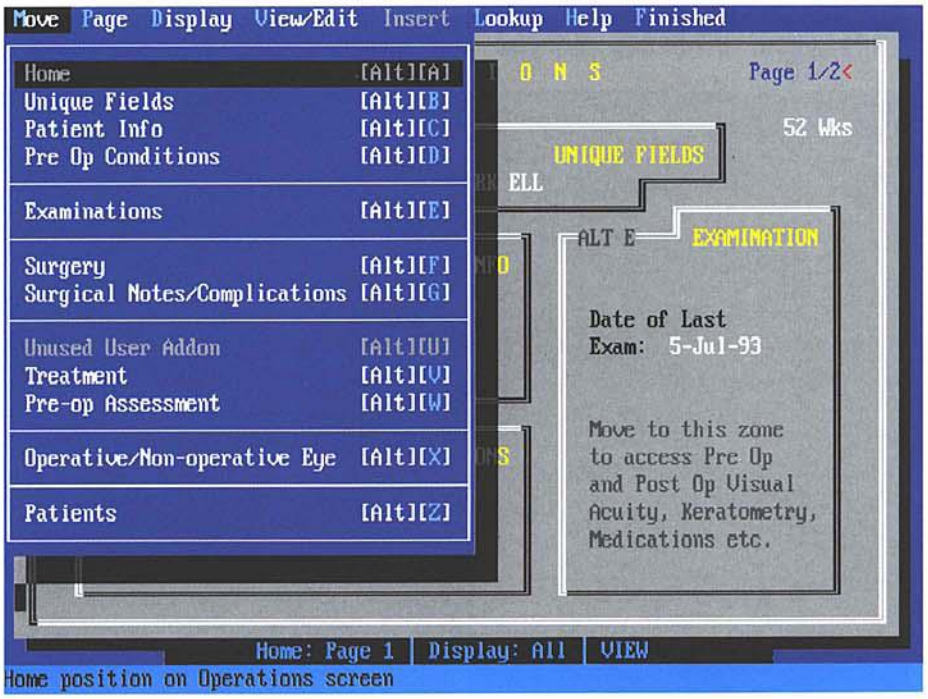
By July 1992, the new improved ASSORT was ready for release. However the release of Paradox 4.0 came first, and a quick evaluation of what it had to offer resulted in ASSORT being converted from Paradox 3.5 to Paradox 4.0. The most compelling reason for doing so was that the form-locking provisions of Paradox 3.5 would have severely restricted network data entry due to the four-tier hierarchy.

Exploiting Paradox 4.0 features

Once the potential to improve the ease of use by employing Paradox 4.0 pull-down menus, mouse support and dialogue boxes was explored, there was no going back. The only problem was that much of the application had to be rewritten to take advantage of the new features.

After the Paradox 4.0 rewrite, two of the client's colleagues took on ASSORT — and inspired a new wave of development. Queries such as "how many patients who have had multifocal lens implanted in both eyes suffer from poor night vision?" quickly killed the idea that a query process dealing with data in 20 Paradox tables would satisfy everyone.

Whilst the first release was being improved to meet an expanded set of



data and new requirements, the client was planning the extension from analysis of past operations to the planning of future operations.

The opthalmic surgeon is a member of the Excimer Laser Research Group of the University of Melbourne, where laser surgery is used to eliminate short-sightedness and at the same time remove astigmatism.

With laser surgery, the treatment requirements are normally determined from the spectacle prescriptions. However, in non-laser surgery such as cataract surgery, the corneal shape is used to determine the treatment. The astigmatism measurements via the glasses and the corneal shape do not always correspond and the client felt that when there are discrepancies, both should be considered and that the treatment should be based on the most appropriate balance between the two.

ASSORT's graphical treatment planning was developed (using graphics code written in Borland C++) to provide this capability. ASSORT was installed at the Excimer Laser Research Group to determine its acceptance and further test its applicability to different practices. Topography (contour mapping of the eye's shape) was also added, and advantage was taken of Paradox 4.0's BLOb field type to store screens captured during topography examinations.

The trickiest requirement was to provide integration with an existing Paradox system yet not customise ASSORT so as to affect its wider distribution. This forced an open architecture approach to be adopted. ASSORT is now "aware" of user-defined tables and procedures so that third-party customisation can take place to handle special needs.

ASSORT application overview

ASSORT is an eye surgery analysis system which starts off by maintaining data on patients, their operations and eye measurements taken at follow-up visits. Provision is made to record operation details such as implant make and model and any procedure or complication of note.

Pre-operative conditions are recorded, so that the effects of these conditions can be taken into account during surgery or later analysis.

Information which may be recorded at pre-operative and post-operative examinations includes refraction (glasses prescription), visual acuity with and without glasses, corneal shape (by keratometry and/or topography), medications, eye pressure, post-operative complications and post-operative procedures. The system automatically creates entries for the non-operative eye as required, and allows the user to toggle between operative and non-operative eye records.

Extensive use is made Paradox's data validation features, most notably lookup tables, of which there are 25. This is essential to ensure that the data entered can be properly analysed. In all cases, the user has control of what is in the lookup tables and in most cases can add to the lookup list during a data entry session.

After the review examination data for an operation is updated, ASSORT recalculates surgically-induced astigmatism and other values according to glasses, keratometry and topography results, and categorises review visits according to the standard review visit frequency for that operation. Visits are also flagged as being preferred or otherwise, so that where more than one visit fits a category, only the preferred visit is used during the analysis to avoid a double counting effect.

Extended analytical features

The main reporting feature is the data analysis reporting. Up to three different query specifications can be specified per analysis. For each specification, six screen pages are used to provide a high degree of selection flexibility. Twelve multi-record Paradox tables are used to handle specification lists such as surgeon, medications and implant supplier. "Private" tables are used so that multiple people can query the database in different ways at the same time.

The default analysis is for numerical data and results in means and standard deviations being calculated. If the same data field is specified for each specification, an unpaired T test is performed automatically to compare the second and third results against the first set. Alternate analysis types include a frequency analysis and one which can be used to determine which patients match one or two sets of criteria.

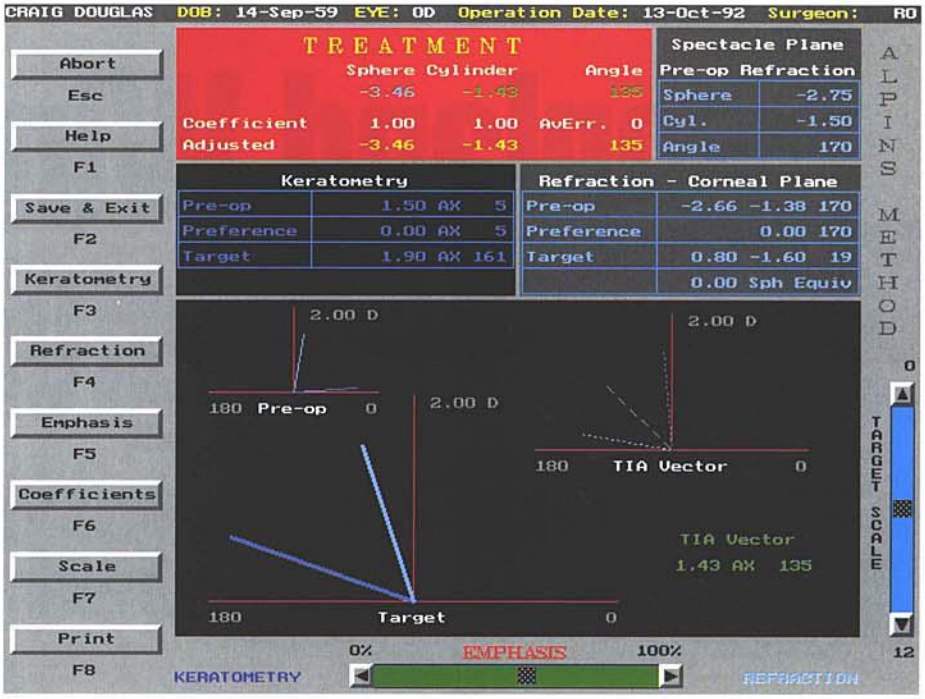
Output available from data analysis includes summary reporting, scatter plots to the screen, full data reporting tabulated by review visits,

saving of data to tables for further analysis or presentation using other packages. Query specifications can be reported or stored in a "catalogue" for re-use later.

The operations extracted may be used to create, add to or replace a study. The use of "studies" means that the same follow-up analyses can be restricted to the same set of operations as that used in the original analysis or to break the analysis process into more easily understood steps.

Paradox 4.0 dialogue boxes are used to obtain specification for sundry reports such as patient lists and review visit reminders. The "Analysis" section of ASSORT is for use by surgeons to plan operations and review the results. Both entered and calculated values for each data area may be inspected by the surgeon.

The "Treatment Planning" module allows the surgeon to graphically adjust targets and vary the emphasis given to values based on spectacle prescriptions and the corneal shape of the eye. The pre-operative and post-operative astigmatism as determined by keratometry, topography and glasses may be viewed in graphical



format (another module written in Borland C++) so that the surgeon can appreciate what is happening over time with each operation. Topography screens saved in Paradox BLOB fields may be viewed as required.

User-defined tables may be linked via multi-table forms (templates supplied) and third-party procedures may be linked to ASSORT. Internal customisation includes the setting up of printers and establishment of calculation method defaults. A utilities menu provides access to the testing of tables for damage, restructuring tables and so on.