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Large Packaged Software: the need for research

Guy Gable
Queensland University of Technology

Roelf van den Heever
University of Pretoria

Judy Scott
University of Texas at Austin

Steve Erlank
University of Cape Town

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Guy Gable
g.gable@qut.edu.au
Queensland U of Technology, Brisbane, Australia

Roelf van den Heever
rvandenh@dos-lan.cs.up.ac.za
U of Pretoria
Hillcrest 0083
Republic of South Africa

Judy Scott
jescott@mail.utexas.edu
U of Texas at Austin
Austin, Texas,
U.S.A.

Steve Erlank
steve@infosys.uct.ac.za
U of Cape Town,
7700 Rondebosch, Republic of South Africa

Executive Summary
A range of influences, both technical and organizational, are encouraging the increasing uptake of large, complex enterprise software packages, which today account for over half the world installed base of application software. The global rush to deploy information technology in support of re-engineering and right-sizing the firm, demands both substantial and relatively rapid change to the information systems portfolio. The backlog in IS departments, problems integrating systems, the inability of legacy systems to cope with the 'Year 2000' problem, and the introduction of Euro currency have further increased demand for these complex 'mega-packages'.

Though application package use has been widespread for decades and packages are now ubiquitous, only a relatively small amount of mostly practitioner and some academic literature exists in the area. e.g. (1) the make vs. buy question [Davis, 1988; Durbin, 1987; Goldmacher, 1987; Kole, 1983]; (2) how to select a package [Klein and Beck, 1987; Ragowsky and Stern, 1995; Sharp and Muhlemann and Price, 1988]; and (3) factors of successful package implementation [Lucas, Walton and Ginzberg, 1988; Lynch, 1984; Trauth and Cole, 1992; Cale and Eriksen, 1994; Davenport, 1996; Edmundson and Jeffrey, 1984; Gross and Ginzberg, 1984; Bancroft, 1996]. Gordon Davis [Davis, 1987] in a plea back in 1987 for increased research into common practice in information systems, made specific reference to packaged software. When queried more recently whether the situation had improved, Davis commented *Although there is some research, the amount of research is not adequate given the importance of packages. Rules of thumb about package use are available in practitioner publications, but they are based on small samples and antecdocal evidence. Adapting an organization to a package rather than custom development, or adapting a package, is a radical departure; the problems and implications have received little systematic, empirical study.*

One consequence of the relatively minor importance apparently attributed to packages by researchers is, in the view to the authors, inadequate attention to package related issues in Information Systems curriculums. Thus, while a significant and growing proportion of Information Systems graduates will be integrally involved with the development, selection, marketing, implementation, operation, maintenance, support, management and use of these packages - complex, enterprise software packages remain largely unresearched and absent from IS curriculums.

In attention to this perceived deficiency in IS research and curriculums, several Universities around the world have developed 'partnerships' with SAP AG of Germany, *the fastest growing major software company on the planet ... annual sales of the software, services associated with it, and hardware on which to run it are estimated at over 10 billion [dollars]* [Davenport, 1996:51a]. Paul Wahl, SAP's North American operations chief executive, maintains that *SAP now has 3000 production sites worldwide and several companies with 7000 or more users* [Australian, 1996b:54]. SAP R/3, their client/server business solution, is a comprehensive software product including financials, logistics, human resources, project management, manufacturing, workflow, high-level development environment and many industry specific application modules. Davenport [1996] maintains that R/3's fully integrated and 'wall-to-wall' character facilitates *higher levels of business coordination than previously possible*. Roelf van den Heever suggests that there are 9000 implementations of R/3 worldwide and 1.5 million users.

This paper presents an early analysis of the potential from using large, complex, enterprise package software products in University teaching and research. Findings derive from mini-case studies of four universities that are either using (UP - University of Pretoria, UT - University of Texas at Austin) or preparing to use (UC - University of Cape Town, QUT - Queensland University of Technology) R/3 in their curriculums. The study explores: the potential for collaboration and joint research and curriculum development across Universities around the world in working with SAP; education-related and other research potential that derives from the partnership and from crediting appropriate importance to packages; key costs and potential problems associated with implementing R/3 within curriculum; topic areas in which student access to R/3 can be beneficial; and resource implications of utilizing R/3 in the different subject areas identified.

The Four Case Universities

Guy Gable from Queensland University of Technology (QUT), first made contact with SAP Australia in late-1995. Queensland Treasury had then just signed an agreement to implement R/3 throughout Queensland State Government. Gable, SAP and the Financial Information Systems Branch (FISB) of Queensland Treasury interacted on a range of issues over the following months, and approximately one year later entered into a partnership whereby QUT would offer package software related education within their curriculum, using R/3 as the vehicle. Gable, FISB and SAP are also discussing alternative collaborative research possibilities.

In 1994, Roelf van den Heever decided that University of Pretoria should explore using SAP in their curriculum. They received the software from SAP in 1995 and hardware was donoated by a local company. In less than 2 years, Van den Heever has facilitated the integration of R/3 throughout the UP curriculum. He has also managed significant synergy from his relationship with SAP and UP. He is chairman and share holder of a private company, EPI*USE, that specializes in SAP R/3 HR consulting. EPI*USE has in the order of 25 R/3 consultants, many of them past UP students. EPI*USE acts as an extended support team for the University activities.

The University of Texas at Austin made initial contact with SAP in late 1995, and held a meeting with SAP executives at UT in April 1996. Following a proposal of how UT would adapt the SAP training materials in an academic environment, SAP drew up a contract which was signed recently. Judy Scott teaches the SAP related classes "Business and Systems Change" and "Cross-functional Integrated Systems". "Business and Systems Change" is not a new course but it has been modified at the urging of the corporate members of the Business School Steering Committee to incorporate the impact R/3 has had on many firms' business processes and application systems portfolios. This course also includes business process reengineering and project management concepts. "Cross-functional Integrated Systems" is a new offering and initially will use the SAP training materials along with related conceptual readings.

Steve Erlank is managing the introduction of R/3 into the curriculum at University of Cape Town (UC). Erlank later this year plans to introduce two new senior specialist half courses in their Information Systems Department. Though experiencing some delays in getting the hardware and software in place, course design is well advanced and the subjects are expected to go ahead as scheduled.

Demand for Package-related Education

SAP's tremendous success over the past several years has resulted in a substantial imbalance worldwide, between the demand for and availability of SAP expertise. Students see the advertisements and many are aware of the market value of SAP exposure. When queried regarding student demand for SAP related instruction at UC, Erlank indicated that *student response has been overwhelming, and the 40 available places are already 2 times oversubscribed, mostly due to perceived employment possibilities.* Scott from UT too indicates that student interest has been high, also mostly related to employment prospects. At this stage, no attempt has been made to gauge student demand at QUT. Nonetheless, Gable indicates that, even though the first subject to be introduced will be an elective aimed at senior undergraduate and graduate students, indications are that we will have to restrict access once availability of the subject becomes known. Maximum class size will be a function of staff availability to supervise and tutor, and student physical access to the SAP R/3 software, the latter of which is a function of the physical facilities and the ultimate licensing agreement. UP's Van den Heever suggests *Students that have been required to use it, found it 'relatively' easy and are eager to discover new facilities, etc. These are second and fourth year computing science students. We do not have experience with the Informatics students [at UP], but I expect they won't have problems either with the work that they will have to do.*

Industry too have shown strong interest in SAP-aware graduates. Erlank indicates that industry interest is growing with increased awareness and that there is a need to manage that interest carefully. Scott suggests that industry interest in Texas has started and that SAP itself is seeking to employ their graduates. Gable suggests that *QUT's partnership with SAP has been to a large extent driven by industry demand, in particular by Queensland Treasury whom have invested heavily in implementing R/3 state-wide.*

Package Use in Curriculum

New subjects which could make extensive use of R/3 and which QUT are considering at this stage include: Integrated Business Information Systems; Business Re-engineering and Electronic Commerce Applications. In addition to stimulating the creation of one or more new subjects, QUT is considering accessing R/3 in a range of existing subjects including: IS Audit and Control (students might audit the IDES sample R/3 implementation); Information Systems Management; and Project Management. UT are running courses on "Business and Systems Change" (which includes BPR), and "Cross-functional Integrated Systems" and are exploring using R/3 in one or more Accounting subjects.

UP are undoubtedly the most extensive and advanced users of SAP in their curriculum. Van den Heever indicates that at UP, *We attempt to expose students only to a subset of R/3 material relevant to whatever course we use it for ... R/3 is a very extensive framework." Subjects in which UP employs the R/3 software include: database systems, software engineering, modeling, accountancy and graduate management.* Following are Van den Heever's comments on each of these.

Students are taught database theory at UP during regular lectures. During practicals they are given an introduction to ABAP/4 [the R/3 development language] and the mechanisms to develop and implement a database in R/3 as well as querying it. This is a second year undergraduate course. We could have used a simpler system, but since R/3 is used by large companies, it is good to be exposed to associated issues.

At UP, R/3 is used as the 'lab part' of the 4'th year course in software engineering. It is used to implement a small manufacturing management system that is based ... relevant R/3 modules. What I like about R/3 is that all the levels of 'management' is represented in one system: from strategic, tactical, operational, down to the wires that connect the manufacturing devices to the system. These are our plans for next year. This year we have given these students only an overview of R/3 with emphasis on workflow, modeling, database design and ABAP programming. R/3 version 3 and higher has a multitude of functionality that may be used to demonstrate and critique a variety of software engineering issues.

Our colleagues from the dept. of Informatics (business data processing) are preparing to use the ARIS toolset for business modeling during the 1997 academic year. They have already acquired copies of ARIS

and visited the developers in Germany. Our students will also be involved in this course. There are other modeling systems that may even be better than ARIS, e.g. from Intellicorp, Centura and Visio. I have a copy of Intellicorp's system that links directly to the R/3 repository.

Informatics is responsible for exposing accountancy students to a real computer based accountancy system. They have made preparations to use R/3 next year for this. The Business School has expressed interest in using R/3 at the graduate level, again in support of courses."

All four Universities are considering alternative means of structuring classes. It may prove appropriate, rather than running the standard (at QUT) 14 weeks, 3 hours per week (lecture/tutorial), to address certain of the material in fewer, more intensive sessions. UC plan to use much of SAP's R/3 training materials initially and are also planning an intensive session for their honors students in order to get them up and running quickly on their R/3 related projects. These students will also be able to provide tutorial support to the regular R/3 class. UP, UT and QUT are also planning to make extensive use of the SAP's R/3 training materials initially.

Resources Required to Use R/3 in Teaching

In order to introduce a large, integrated software product like R/3 for research and education, substantial resources are required, including: software, hardware, technical support, and academic staff training. Gable, who is currently negotiating arrangements with SAP Australia, suggests that SAP have been very forthcoming given QUT's foundation partner status in Australia. They are donating full use of the R/3 modules for use in teaching and research activities. They are also arranging for the donation of a suitable and substantial server through one of their hardware partners. Gable further observes that SAP have been entirely receptive up to this point, *to our sending a small number of staff along to their regular R/3 courses run in Brisbane, Sydney, Canberra and Melbourne and have also offered implementation assistance and ongoing support through their hotline.* Erlank has creatively recruited assistance from industry, and has outsourced much of the lecturing to consultants involved with SAP in practice.

Gable suggests that the QUT server will be sized to accommodate the next major version - R/3 4.0, scheduled for release late 1997. UP, UT and UC are now, or are planning to run R/3 under various versions of UNIX. QUT are yet considering their options, which also include Windows NT. While R/3 can be configured with very 'thick clients' if preferred (much processing and functionality distributed to the clients), functionality on the clients will be kept to a minimum initially at QUT in order to make R/3 on the server accessible to the widest possible range of PCs and PC labs in the faculty. With this configuration of 'thin clients', the PCs can be running any of Windows 3.1, 95, 97, NT, Unix, Solaris, ... on as little as an 80286 with 8 Megabytes of memory. Ultimately, the number of work stations able to concurrently access R/3 will be a function of licensing, server capacity, and the nature of access (what things the students are doing with it).

At the University of Texas Austin, a Chief Technology Officer, who is on staff on one year's leave from Hewlett Packard, provides expertise on infrastructure issues and has organized a loan of a server to run R/3. Price Waterhouse (PW) has shown interest in an alliance with UT, whereby PW influences course development and provides expertise from their consultants who have had experience with R/3 implementations.

When queried re SAP support for the initiative Van den Heever indicates, *They prefer us to be self sufficient. But they are extremely helpful on all other levels. Some of their employees deliver guest lectures. They are not prepared to send a consultant to our premises - I expect it is because of the financial implications. We do not have funds to pay for such people. All R/3 software is given free of charge to us and we get all new versions and updates on a regular basis. This is a significant 'donation' ... Our relationship at this stage is quite good. We really receive access to a significant system.*

The Need for Education Related Research

As observed previously, regardless of the ubiquity of packaged software there continues to be a dearth of package related research. In evidence of this lack, a search of research interest areas in the ISWorld Net Faculty Directory at: <http://webfoot.csom.umn.edu/isworld/facdir/home.htm> employing the keyword 'package', yielded only 16 hits on the 5000 or so researchers in the directory. There will be those who

argue that packages are simply custom applications installed in multiple locations. This implies that the design of packages is much the same as that of one-off custom software. One doesn't have to dig very deep to be convinced that this is not the case, and that designing software for resale is quite a different undertaking. Carmel and Becker [1995:50] suggest that *As software development migrates from its roots as a process for building a custom product to a process for building packaged products, there is a greater need for an appropriate product development process model that is market-oriented.* Whether or not one is interested in preparing students to work with packages, the prevalence of packages would seem to warrant greater research attention. Knowledge of and involvement with SAP can facilitate related research collaboration. Erlank reports that *There are more offers on the table for research and joint projects than I can accommodate at the moment ... much interest has been shown to date by large management consulting firms. Scott says that PW is interested in influencing our course development. SAP America wants to do joint research on training materials.*

Again in terms of research and consulting, UP are further advanced than the other case Universities. Van den Heever indicates, *We have received funding from industry and the government for developing R/3 based tools. There are basically 2 categories currently: information systems in support of management for HR payroll and the development of simple and user friendly user interfaces for specifications of payrolls. In both categories we can count on the domain knowledge available at EPI*USE. I will have approximately 8 student assistants available next year for these projects.*

For the purposes of this continuing study, and with the objective of stimulating further interest in package use in IS curriculums, following is a laundry-list of research questions compiled by the authors and which will be debated by a panel of the authors at the Pacific Asia Conference on Information Systems, Brisbane, April 1997, include:

- Should packaged application software be addressed specifically in IS curriculums? In what ways and to what extent? In what ways are packages addressed in IS curriculums currently?
- What are the implications of employing a proprietary software package for teaching purposes? What factors moderate these implications? (e.g. pervasiveness of the package in the world/regional/local market, anticipated longevity of the package, demand for package related expertise/experience, complexity of implementation/operation and support ...)
- To what extent are IS professionals working with packages and in what capacities? To what extent are non-IS professionals working with packages and in what capacities? Could/should IS professionals have a greater or lesser involvement?
- Do IS graduates have appropriate preparation for the roles they play in relation to packages? Do they have appropriate preparation for roles they could/should play?
- In what ways is package implementation different from implementing custom software? What differences in the roles and expertise of the implementation team do these differences suggest? What differences in IS curriculums do these differing roles/expertise suggest?
- How can large, complex software packages be usefully employed in more traditional, mainstream subjects such as the 10 recommended for an IS Major in the IS'95 Model Curriculum.

Further Data Collection

Further data collection planned as part of the current exploration of issues surrounding package use in teaching include: (1) feedback from SAP R/3 panel members on the working paper, (2) a panel discussion at PACIS'97, (3)) a student awareness survey, and (4) an industry demand survey. First, this early working paper, is being circulated amongst the case participants for feedback and input. This process will continue throughout the study. Second, prior to advertising the availability of the SAP R/3 subject(s) at QUT, an email survey of all students in the Faculty of Information Technology will be conducted with the objective of gauging student demand and interest and the need (or not) for promoting the subject(s). Third, a panel discussion at the Pacific Asia Conference on Information Systems, 1-5 April 1997, Brisbane, Australia, with this paper as the focus of discussion and involving the four authors and the audience, will be tape-recorded and transcribed for analysis. Lastly, a survey of local and regional industry is planned with the objectives of: a) identifying what roles SAP R/3-aware undergraduate and graduate students might assume in practice (e.g. implementers, trainers, systems administrators); b) gaining feedback on what combination of subjects and experience would most complement SAP R/3-

awareness in undergraduate and graduate students seeking employment in the various SAP R/3-related roles identified in (a); c) assessing industry demand for graduates who have had significant SAP R/3 exposure (are SAP R/3-aware), and perhaps whom have the specific combinations of SAP R/3 awareness and other subjects identified in (b) in relation to the various roles identified in (a). This will allow us to 'package' our material to students in order to maximize their marketability in SAP R/3 and other large-package related roles. It will also identify any key deficiencies in our 'package' of subject offerings.

Other Areas of Important Research Potential

Other important package implementation and use related research questions, which while important topics in package related curriculum, are not specifically aimed at understanding package use in curriculum, include:

- Should requirements be specified in the same way when choosing a package, as they are for designing and developing a custom system?
- To what extent and in what ways are packages (or could they be) designed to: accommodate add-ons/front-ends/back-ends and facilitate upgrading to new versions without losing custom enhancements. How easy or difficult is it to assess this characteristic of software packages? What sort of commitment to this characteristic can be gained from vendors?
- What cultural or other Australia (or South Africa or USA) specific contextual factors should be taken into consideration when implementing SAP R/3
- What unique characteristics of SAP R/3 should influence the audit of SAP R/3 implementations?
- What unique characteristics of SAP R/3 should influence its post-implementation review?
- How can SAP R/3 be effectively implemented in medium-sized enterprises in Australia?
- What are the costs of switching from legacy applications to the new mega-packages? Do organisations tend to fully anticipate the organisational costs of implementing a mega-package? Are the issues the same for small packages? Large packages? All packages? What factors moderate the issues?
- What 'barriers to the adoption' of packaged software exist today? How do these compare to those identified by Gross and Ginzberg in 1984? What has caused these issues and their relative importance to change over time?
- Do the structure and curriculum and constraints of the academic year prevent us teaching large complex packages? Does the current crop of undergraduates have the necessary prerequisite knowledge and skills to teach them large, complex packages?
- R/3 represents results of programming-in-the-colossal (Booch) based on components, objects, ... How should this be taught and researched?
- How can SEI's Capability Maturity Model (CMM) be used in this context, i.e. customisation in context of large application frameworks?
- represents significant complexity in terms of amount of detail, relationships, the problem of finding reusable artifacts. How should this be approached?
- Does R/3 represent generic aspects. Generic aspects will hopefully be transferable to other large application frameworks. SAP employs many highly academically qualified people. Some of the artifacts created by them reflect their deeper insight and considerations.
- How to mesure ROI on package related investments?
- To what extent does package software drive BPR versus BPR driving the acquisition of packages?
- How to manage the significant organisational changes resulting from the introduction of large integrated packages (e.g. new processes, staff changes, broader roles, etc.)?
- Whether to, and how to, integrate other third party software with packages (ie. whether to integrate add-ons or live with R/3 functionality)?
- Why are some R/3 implementations far more successful than others?
- What are the benefits that management perceive from internet/intranet enabled packages?
- What criteria should management employ in deciding to retain or not certain of their legacy applications, when introducing large packages?

Note, that while several of these issues are addressed anecdotally in various MIS texts (e.g. [Laudon and Laudon, 1994]), very little substantive research has been done into these important issues.

Conclusion

A major concern of all of the case Universities is that they not be perceived as aligning themselves too closely to any particular vendor or product. Scott suggests *We do not want to appear biased towards a product, but R/3 is the industry leader for enterprise software applications and thus provides a worthy exemplar.* Erlank says, *Universities as a rule should not teach 'products'.* Nonetheless, Universities must choose between vendors all of the time, when choosing computers, printers, decision support software, DBMS, etc.

Thus, one must ask the question, "why is there not more research and teaching related activity into packaged software?" Possible reactions to this question include: packages are no different from bespoke software thus the issues are the same; packages are different from custom software, but the bundle of concepts, theory and practical exposure we give our students is already sufficient for both custom development and packages; anyone with package expertise can earn more working with packages in the marketplace than they can researching them. While the authors may agree with the last listed point, they obviously do not agree with the first two listed views. Van den Heever suggests that *R/3, a large application framework, represents a paradigm shift in software development. We have to sort out what the generic aspects (science?) are and concentrate on them during our teaching and research.* Given the strong and continuing trend away from in-house software development to increased use of software packages, we may be teaching students inappropriate material if we ignore packages. However, teaching software packages in universities raises many issues that need to be addressed. Cross-university collaboration can help with lessons learned and avoiding pitfalls. It is believed that packages have become so important that using packages to simply teach about packages, is reason enough to employ them in teaching. Nonetheless, packages can be useful for teaching a range of concepts.

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