

End-User Computing: *Planning EUC Systems*

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I. INTRODUCING END-USER COMPUTING

The concept of End User Computing (EUC hereafter) came to rise in the 1980s [1],[2], partly thanks to the increasing interest in Management Information Systems (MIS) [2]. Brancheau and Brown [3] define an “End User” system as *“the development of computing applications by the people who have direct need for them in their work”*, considering it a familiar subject as early as 1993. Benjamin [8] suggested that even as early as 1990 such systems will occupy *“as much as 75% of the corporate computer resource”* [30],[31]. The uptake of end-user systems has been particularly prevalent in the fields of a) technical or scientific disciplines where such *“information systems have been placed in the hands”* [3] of industry professionals and b), the commercial or business environment where relevant staff have been provided with systems that are typically adjusted for the given business role [3]. With growth in the use of information systems (IS) there has been an increasing demand in suitable front-end interfaces that provide a *“richer and more flexible communication channel[s]”* [3], though this has caused knock-on effects in providing reduced system standardisation—the results of which being the need to develop suitable management strategies to control and regulate the use of such systems [3] *“in the support of organisational tasks”* [4]. Since the rise in end-user software, the uptake and popularity of personal computers in the workplace and the hardware on which users wish to work has also taken place[5]. Known as “Bring Your Own Device”, tight company policies and IT management of such devices and software are fundamental, but in some instances are alright in place that cover the proceeding end-user software revolution [6],[7].

Fig. 1., shown below, places various common end-user systems on a matrix positioning the learnability of the end-user development environment and/or program against its flexibility and/or customisability. Given the wide nature of systems designed and used by an “end user” there are a variety of different options though it is proposed by Leithelser and Wetherbe [8] that the development of such a system stems from staff dissatisfaction at an MIS departments ability to provide easy to use, flexible software; even believed by some to have been developed from a perspective that does not understand the software context or the needs of its user [8].

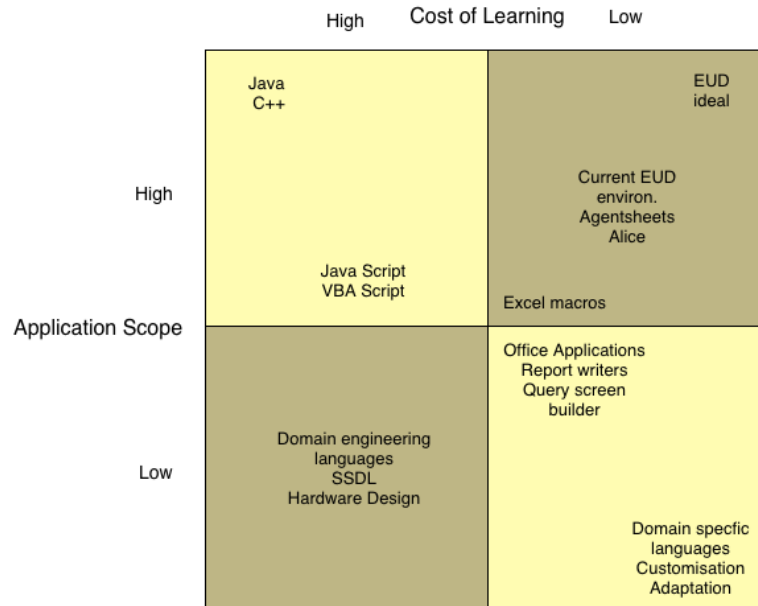


Figure 1: the balance between versatility and learnability for various EUC languages/tools [9]

Relational database packages can be linked together to increase the interoperability of end-user systems [5], as highlighted in **Fig. 1.** with the most popular systems being that are typically more complex for a user to learn. The popularity of tools such as Macros and Packages such as Office is the relative customisability and reduced learnability required to develop a workable system. Huff *et. al* [12] suggest that “*applications become more sophisticated as time passes*” [12] and that activities “*EUC organisational training, support and managerial activities are thus driven by individuals ... developing more complex and mature applications*” [12] so the nature of the end-user developer environment influences formal corporate responses.

Alavi, Nelson and Weiss [10] propose various strategies firms can take on the management and support of EUC systems in a work environment that range from a “Laissez-faire” approach with little monitoring of devices, activities or central direction regarding the use of personalised end-user systems [10], through to an “Acceleration Strategy”. This end of the spectrum concentrates on pursuing a firms push towards “*increased EUC activities and user satisfaction*” [10] by not being too concerned by the form of end-user environments. This architecture is typically implemented with the use of “Information Centres” [10] that act as a central point of reference and staff support, such a help desk ran by in-house IT service specialists. This encourages the development of new end-user systems for employees [10] with relatively little management control. Though the latter is a common approach, a “Monopolist strategy” is required in some instances, such as those in safety critical environments, that tightly regulates the use of such systems through appraisals and “*prespecified boundaries*” [10]. Less natural evolution might impact a firm’s technology innovation.

Given the highly broad nature of EUCs the process of system evaluation too is complex. The various evaluative frameworks for EUCs are primarily based on softer user-perception rather than harder quantitative data thanks, at

least in part, to highly abstract nature of a user's individual system [13]. Based on similar proceeding frameworks [14],[15], Etezadi-Amoli and Farhoomand [13] present a 27-question criterium sheet for EUC evaluation, as can be seen in *Appendix a*), whereby staff score each measure for satisfaction (between “-2” [most displeasure] and “2” [most satisfied]); [13] and importance (on a scale of “0” [little importance] to “3” [of most importance]) [13] to determine the relative success of the end-user solution. The complete framework can be seen in *Appendix A*). Research suggests that developers outside the IS dept. are developing incorrect applications [16], not necessarily thanks to the range of tools, but more the lack of end-user familiarity and formal testing, the prevention and reduction of errors is a responsibility shared between IS researchers, corporate management and IT departments [17] and can result in mixed evaluation in frameworks such as Etezadi-Amoli and Farhoomand's tool [13]. Works by Bailey and Pearson [14] and Doll and Torkzadeh [18] have attempted to link the change in data and interface layout to enhanced user satisfaction gained when using software [19].

II. HEALTHCARE EUCS

Healthcare systems rapidly evolve thanks to the need to meet new diagnostic or therapeutic changes, changes to departmental of employee structures and external factors including “*pressure towards hospital mergers and healthcare integrated networks*” [20]. The healthcare context presents precise characteristics as the use of software is not typical, instead the system staff members use depends on the role of the individual. There is also a distinct level of interconnectivity between healthcare departments that demands a given end-user system in order to fulfil the need for close collaboration [21] and system interoperability. This operational alignment ensures that healthcare systems must provide data integrity, ease of staff use and suitable levels of information access “*without risking quality of [patient] care*” [21]. ‘Healthcare Information Systems’ (HIS) [22],[23] or ‘Clinical Information Systems’ (CIS) [24], systems that store, process and retrieve client information for clinical staff to aid their process of care and patient treatment [24], are considered to generally not provide end-user satisfaction [25], Despite this however, it is vital given the sensitive and complex nature of information generated from hospital patients. Initially such platforms were only used to manage financial information, yet the expansion of technologies has seen a broad and complex use of technologies explored in patient care and diagnosis procedures with varying degrees of usability and system compatibility [23]. Rodger, Pendharkar and Paper [26] suggest that the “*end-user perception of IT*” can be seen in staffs’ relative adoption of digital systems in directly performing task-related work, the administration of healthcare structures and the uptake of ‘Total Quality Management’ (TQM) processes to provide long-term departmental direction. This comprehensive metric defines the relative success of end-user systems in performing a diverse range of activities associated with the administration and performance of a healthcare environment [26]. These principles suggest that part-uptake of a new end-user platform or system is not enough, it must be universally accepted by staff in a safety critical system where information continuity is fundamental, part of which relies on suitable testing alongside electronically delicate equipment. [23].

HIS systems must also ensure confidentiality. In a study performed by Sinha and Kurian [23] in a group of 127 clinical respondents around 54% of staff were “moderately satisfied” [23] with the system – only 3 respondents considered themselves “extremely satisfied” [23] with their end-user experience, this had a direct influence on patient confidentiality with more than half the staff merely “moderately satisfied” [23] with the existing systems ability to maintain patient privacy.

III. MANAGEMENT INFORMATION SYSTEM DISCUSSION & DESIGN

Note: For the purposes of this assignment not all Excel components have the desired level of functionality, nor visual design. Various controls have been explored in order to discuss how the system would need to perform. Not all navigational controls have been added for the problem discussion.

A) Booking customer appointments

The end-user system revolves around a sheet in Excel containing ‘base’ information from which various lookup and controls reference. The range of procedures carried out by the Dental practise are outlined in the “Dentist_Core_Data” table, along with all current ‘base’ information. This screen, essential for the dental practice in ensuring appointment and opening hours continuity, is shown below in **Fig. 2.**

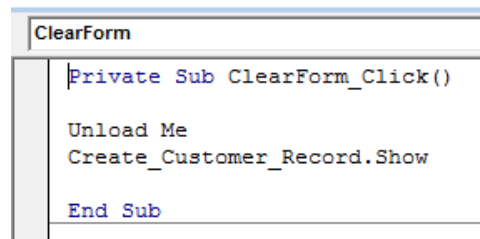
"Your Teeth Our Smile" Current Dental Information				
Dental Job	Price	Rooms	Months	Week Rota
General 9-month checkup	£45	Theatre A	January	1
General 12-month checkup	£65	Theatre B	February	2
General 6-month child checkup	£45	Theatre C	March	3
Braces	£125	Hygenist Room 1	April	4
Root Canals	£150	Hygenist Room 2	May	
Crown Fillings	£150	Large Theatre	June	
Bonding	£100		July	
Teeth Whitening	£75		August	
			September	
			October	
			November	
			December	
Home				

Figure 2: Dental practice reference information

Each Room has its own sheet containing the customer bookings for each timeslot during a typical working day for the Dental Practise, as show in **Fig. 4.** This shows the various appointments for 4-week (month) period. For a

member of administrative staff to add a customer booking the sheet shown in **Fig. 5.** will be used. The user must first select a room, then a week number using the dropdown ‘combo-boxes’ above the booking entry form.

Having added all bookings (via the “Create Booking” form shown in **Fig. 6.**) into the corresponding time slot on the data entry table all the booking(s) in the table can be sent to the corresponding week of the selected room (shown below in **Fig. 3.**). Resetting the booking entry form works similarly to that contained within the Customer registration whereby the form is closed and then reloaded, as shown below in **Fig. 3.**, though this is used in the customer form this VBA is reusable [27].



```
ClearForm
Private Sub ClearForm_Click()
    Unload Me
    Create_Customer_Record.Show
End Sub
```

Figure 3: Clearing a form by reloading it

By sending the form contents to the data entry table changes can be made as required. The booking information from the form is a customer’s identifier and given procedure. Although a Dentist name is provided this is merely for administrative purposes and, although given to the customer on their invoice, could be subject to change.

For the purposes of this assignment 5 rooms are listed as it is assumed the practice is modestly sized and consists of three main theatres, two hygienist rooms and a larger theatre used as required.

Dental Theatre A																						
Week 1		Booking Slot																				
	Day	08:00-08:30	08:30-09:00	09:00-09:30	09:30-10:00	10:00-10:30	10:30-11:00	11:00-11:30	11:30-12:00	12:00-12:30	12:30-13:00	13:00-13:30	13:30-14:00	14:00-14:30	14:30-15:00	15:00-15:30	15:30-16:00	16:00-16:30	16:30-17:00	17:00-17:30	17:30-18:00	18:00-18:30
	Monday																					
	Tuesday																					
	Wednesday																					
	Thursday																					
	Friday																					
	Saturday																					
Sunday																						
Week 2		Booking Slot																				
	Day	08:00-08:30	08:30-09:00	09:00-09:30	09:30-10:00	10:00-10:30	10:30-11:00	11:00-11:30	11:30-12:00	12:00-12:30	12:30-13:00	13:00-13:30	13:30-14:00	14:00-14:30	14:30-15:00	15:00-15:30	15:30-16:00	16:00-16:30	16:30-17:00	17:00-17:30	17:30-18:00	18:00-18:30
	Monday																					
	Tuesday																					
	Wednesday																					
	Thursday																					
	Friday																					
	Saturday																					
Sunday																						
Week 3		Booking Slot																				
	Day	08:00-08:30	08:30-09:00	09:00-09:30	09:30-10:00	10:00-10:30	10:30-11:00	11:00-11:30	11:30-12:00	12:00-12:30	12:30-13:00	13:00-13:30	13:30-14:00	14:00-14:30	14:30-15:00	15:00-15:30	15:30-16:00	16:00-16:30	16:30-17:00	17:00-17:30	17:30-18:00	18:00-18:30
	Monday																					
	Tuesday																					
	Wednesday																					
	Thursday																					
	Friday																					
	Saturday																					
Sunday																						
Week 4		Booking Slot																				
	Day	08:00-08:30	08:30-09:00	09:00-09:30	09:30-10:00	10:00-10:30	10:30-11:00	11:00-11:30	11:30-12:00	12:00-12:30	12:30-13:00	13:00-13:30	13:30-14:00	14:00-14:30	14:30-15:00	15:00-15:30	15:30-16:00	16:00-16:30	16:30-17:00	17:00-17:30	17:30-18:00	18:00-18:30
	Monday																					
	Tuesday																					
	Wednesday																					
	Thursday																					
	Friday																					
	Saturday																					
Sunday																						

Figure 4: Each room containing each 4-week schedule

Select a Room	Hygenist Room 1	▼
Select a Week Number	2	▼
Day	08:00-08:30	08:30-09:00
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

Figure 5: Selecting a room and week to enter customer appointments

The image displays two versions of a 'Create Booking' form. The left version shows the 'Customer ID' dropdown menu open, revealing a list of numbers from 1 to 8. The right version shows the form with the dropdown closed and the 'Customer ID' field populated with the value '1'. Both versions of the form include the following fields: 'Customer Forename', 'Customer Surname', 'Customer Procedure', 'Procedure Date', 'Procedure Time Slot', 'Room', 'Dental Staff', and 'Date of Booking'. At the bottom of the form, there are four buttons: 'Copy to Database', 'Clear Booking Form', 'Add Booking to Schedule', and 'Send to Invoice'.

Figure 6: "Create Booking" Form

The "Create Booking" form contains both Customer ID number and Forename and Surname fields with the ID field being sent to the appointments record database and Forenames and Surnames added to the customer invoice sheet. It would not be suitable to provide the user with purely their unique identifier on the invoice as it should be the appointment booking at a glance. Currently, a list of sample customers are shown in "View_Customer_Records" table to provide a CustomerID definition, seen below in **Fig. 7.** The use of a customer tables is also required for marketing and booking purposes as an individual that has not registered with the practice shouldn't be able to book a procedure until they have signed up. The names and various contact details for marketing or appointment reminder purposes are also typical in both healthcare and booking system scenarios.

"Your Teeth Our Smile" Customer Database						Create Customer Record		
CustomerID	Customer Surname	Customer Forename	Address	Telephone No.	Contact Email	PostCode	DOB	Registration Date
1	Willis	Jessica	18, High Street Terrace, Swansea	07462145667	jwillis@gmail.com	SA24WE	12/03/94	19/04/00
2	Jones	Jack	15, New Court, Landore, Swansea	07821563212	jackbjones@live.com	SA34SU	16/03/92	23/02/04
3	Smith	Sarah	24B, Southcote Rise, Newton, Swansea	07624576898	smiths@outlook.com	SA34FU	27/07/85	03/11/95
4	Smith-Rowe	Emile	14, New Road, Uplands, Swansea	07787432121	esmith-rowe@afc.com	SA128SD	08/06/98	22/10/17
5	McBurnie	Oliver	12, Southview Rise, Mumbles, Swansea	07754123221	mcburnieo@swansea-cityfc.com	SA37JK	27/03/94	22/01/16
6	Wilson	Eileen	18, The Orchard, Newton, Swansea	07754678551	ewilson@live.com	SA32QW	18/02/60	15/12/85
7	Harrow	John	15, Southview Road, Newton, Swansea	07764123889	johnharrow@live.com	SA36RT	09/11/16	28/01/90
8	Jones	Bethan	3A, Kelmscott Terrace, Uplands, Swansea	07756612314	bsmithjones@gmail.com	SA45FD	04/12/93	02/17/16
Home								

Figure 7: Customers of the practice added to the system

B) Creating Customer Invoices

The “Create Booking” form is central to the system, it allows a user to copy its contents to an invoice sheet, as well as sending information to the room schedules and to the bookings database sheet (containing long-term records). **Fig. 8.**, below, shows the completed appointment form and the option to copy to an invoice for the customer.

Create Booking

Customer ID:

1

Customer Forename:

Jessica

Customer Surname:

Willis

Customer Procedure:

General 9-month checkup

Procedure Date:

14/03/18

Procedure Time Slot:

13:30-14:00

Room:

Theatre B

Dental Staff:

Dr. G. B. Smith

Date of Booking:

02/03/18

Copy to Database

Clear Booking Form

Add Booking to Schedule

Send to Invoice

Figure 8: Contents of the booking form can be exported to various locations

In this system an invoice can be generated when the booking is made to act as a customer reminder, though to ensure a complete invoice payment is expected be taken upfront--before the operation have taken place. This is a design decision that might require further exploration when the system is in development and further consideration. On clicking “Send to Invoice” the cell contents, seen in the VBA “Developer View” below, should be copied into the appropriate cells in the invoice sheet, as displayed in **Fig. 9.** *The code below is used to perform this action on the customers table to register an individual onto the system but the process of copying to the invoice from the registration form takes a similar form, albeit between different form controls and database sheets.*

```
Private Sub AddCustomer_Click()  
  
    'Go to top left cell of table  
    |  
    Sheets("View_Customer_Records").Select  
    Cells(7, 2).Select  
  
    'Add a new top table row  
    ActiveCell.EntireRow.Insert  
  
    'Insert following customer details  
  
    Sheets("View_Customer_Records").Cells(7, 2) = Create_Customer_Record.tbID.Value  
    Sheets("View_Customer_Records").Cells(7, 3) = Create_Customer_Record.tbSurname.Value  
    Sheets("View_Customer_Records").Cells(7, 4) = Create_Customer_Record.tbForename.Value  
    Sheets("View_Customer_Records").Cells(7, 5) = Create_Customer_Record.tbAddress.Value  
    Sheets("View_Customer_Records").Cells(7, 6) = Create_Customer_Record.tbTeleNo.Value  
    Sheets("View_Customer_Records").Cells(7, 7) = Create_Customer_Record.tbEmail.Value  
    Sheets("View_Customer_Records").Cells(7, 8) = Create_Customer_Record.tbPostCode.Value  
    Sheets("View_Customer_Records").Cells(7, 9) = Create_Customer_Record.tbDOB.Value  
    Sheets("View_Customer_Records").Cells(7, 10) = Create_Customer_Record.tbDOR.Value  
  
End Sub
```

Figure 9: Adding a new table row then copying in the contents of a form [28]

Here is the filled-out invoice using the same information as shown below above in the form view. Not all information from the form is copied into the customer invoice. Similar their unique Identified, and room number, are both omitted as it is assumed that a customer must, on arrival, sign in at the dental practise’s front desk. This process ensures a patient has arrived for their appointment during which any room or assigned dentist changes can be communicated.

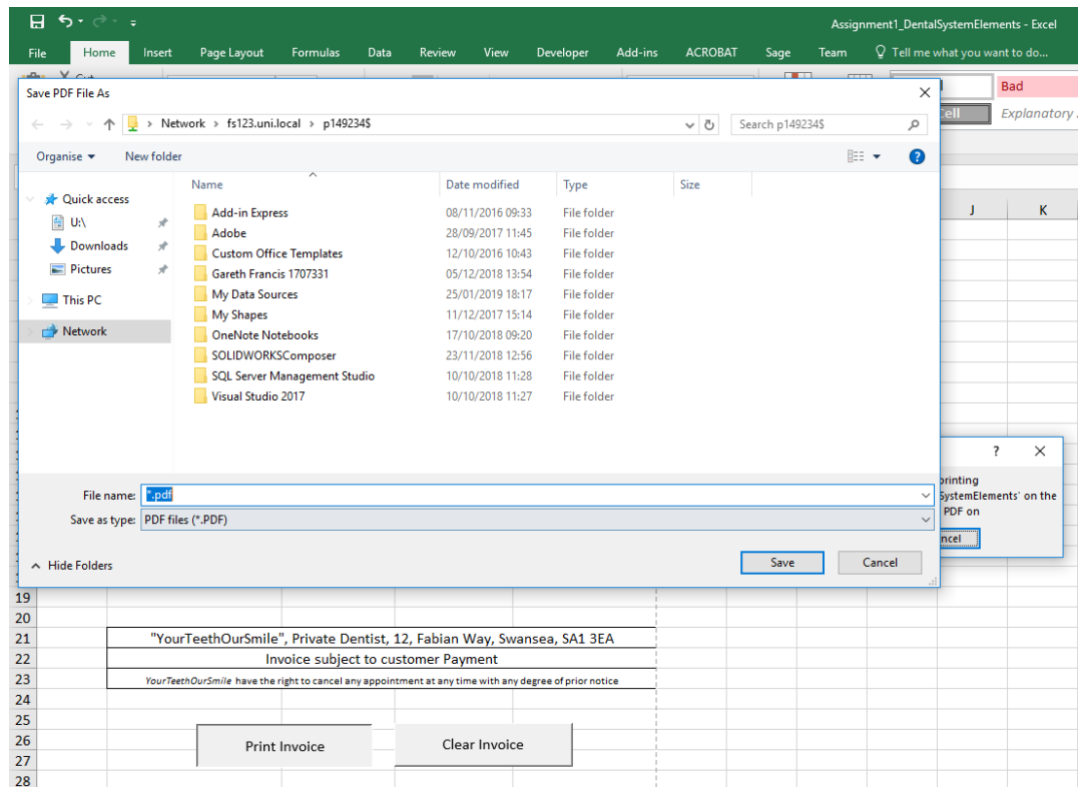


Figure 12: This VBA line prints sheet as a PDF file via file explorer

D) Send appointment record to database and clear invoice form

To store a long-term record of patient appointments a separate table has been added that contains customer booking information. To fill this table the process of creating a booking using the “Create Booking” form, shown below in **Fig. 13.**, allows the information contained within to be copied to the “Bookings_History” table using VBA code similar to that used in the customer registration process. This selects the form text box and then copies to the corresponding cell--seen below in **Fig. 14.**

Customer ID: 1

Customer Forename: Jessica

Customer Surname: Willis

Customer Procedure: General 9-month checkup

Procedure Date: 14/03/18

Procedure Time Slot: 13:30-14:00

Room: Theatre B

Dental Staff: Dr. G. B. Smith

Date of Booking: 02/03/18

Copy to Database

Clear Booking Form

Add Booking to Schedule

Send to Invoice

Figure 13: copying to database table from the "Create Booking" form

```

End Sub
Sub Clear_Invoice_Form()
' Clear_Invoice_Form Macro
'
Range("C6").Select
ActiveCell.FormulaR1C1 = ""
Range("C8").Select
ActiveCell.FormulaR1C1 = ""
Range("C10").Select
ActiveCell.FormulaR1C1 = ""
Range("C12").Select
ActiveCell.FormulaR1C1 = ""
Range("C14").Select
ActiveCell.FormulaR1C1 = ""
Range("C16").Select
ActiveCell.FormulaR1C1 = ""
Range("A1").Select
End Sub

```

Figure 14: Clearing the invoice form (form is shown in *Fig. 9.*)

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V. APPENDICES

Appendix A)

Etezadi-Amoli and Farhoomand’s [13] “*structural model of End-User computing satisfaction and user performance*”

Etezadi-Amoli and Farhoomand Framework
A. Attitudinal measures

1	Usefulness of the context of the user manual
2	Usefulness of the index to the user manual
3	Currency of the user manual (up-to-date)
4	Completeness of the user manual
5	Ease of understanding and following user manual
6	Clarity of description of functions / commands displayed on-screen
7	Ease of remembering the functions / command names
8	Reliability of the software
9	Completeness of the software features
10	Speed of interacting with the system
11	Ease of detecting possible errors
12	Ease of correcting errors
13	Ease change of the output format
14	Accuracy of the output information
15	Ease of understanding the output
16	Completeness of the output information
17	Availability of output when it is needed
18	Adequacy of training provided
19	Amount of support provided by vendor or other sources
20	Top Management support for your personal computing
21	Availability of information system staff for consultation
22	Adequacy of communication links with corporate database
23	Ease of recovery of lost or damaged information
24	Safeguarding the computer system from physical loss or damage
25	Safeguarding the computer from unauthorized access
26	Safeguarding data from physical loss or damage
27	Safeguarding the computer from unauthorized alteration
<i>B. Performance-related measures</i>	
28	Overall, how successful has your software been in improving the quality of your work?
29	Overall, how successful has your software been in making your job easier?
30	Overall, how successful has your software been in saving you time?
31	Given the overall cost, how successful has your software been in helping you fulfil the needs and requirements of your job?