

Issues that support the creation of ICT workarounds: towards a theoretical understanding of feral information systems

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Abstract

End Users apply nascent creativity (inherent inside the ES study in question), adaptive behaviours, and 'bricolage' to develop solutions that establishes connections between the required business practices and the ES. One solution is a type of ICT workaround, a Feral Information Systems (FIS). We define an FIS as a workaround designed to achieve certain requirements using any information technology tool that an End User employs in conjunction with, or instead of the mandated Information System. To explore this, we conducted a case study at a large utility company. We conclude that Feral Information Systems are not a behavioural deviance. FIS are a by-product of End Users seeking operational efficiency; namely to nullify additional transactional costs imposed by the Enterprise System.

Our findings suggest that end users of Enterprise Systems (ES) will fall into one of four modes of operation. Mode 1 is when End Users submit to the ES. Mode 2 occurs when the End User dismiss the ES. Mode 3 is to develop a workaround (FIS) that remains hidden from the ES proponents. Mode 4 is when the FIS operate in open defiance of the ES proponents. This research deliberately takes the practitioner view and therefore outlines how different pressures help to create FIS as a response to poorly mandated ES. We also make a theoretical contribution by exploring issues that lead to workarounds and suggest that future research on exploring these modes of operation can be theorised in future proposed studies.

Keywords: Feral Information System, Workarounds, Shadow Systems, Modes of Operations, Structuration Theory

Introduction

An Administration Officer, on the bottom rung of the organisational chart, keeps project related information in a desktop spreadsheet, using data gathered from the paperwork that crosses the desk. When the business prepares its Annual Report, it uses the some of the data contained in this spreadsheet in preference to similar data stored in the multi-million dollar Enterprise System. An Engineer uses a Packet Sniffer device to determine the username and password that the Enterprise System desktop client is using to access the backend databases. The Engineer then

reverse-engineers the SQL obtained from Packet Sniffing to develop a user-friendly web-based front end that mashes Enterprise System data with other project related information. The web page becomes so popular that over 10% of the business has used it. Each month an Accountant does a massive data dump from the Enterprise System. Pushing desktop spreadsheet and database technology to its very limits, the Accountant regroups and reformats the financial monthly reports.

This paper examines the interaction between the Enterprise System (ES), ES End Users, and the *ad hoc* IT tools that the End Users developed as work-arounds to the ES. We call these work-arounds Feral Information System (FIS). Alter (2014) argued that there is no real theoretical framework to conceptualised workarounds and that they usually exist as a means to join some loosely coupled systems or to plug the gaps between elements to complete a process. FIS are a by-product of End Users seeking operational efficiency; namely to nullify additional transactional costs imposed by the Enterprise System. That is, by cost transfers onto End Users by both internal ES proponents (e.g. ES implementation team) and external ES proponents (e.g. Vendors and Consultants). Feral Information Systems are an innovative solution developed during a period of crisis for the End User. The crisis occurs when ES proponents corner the End User into resolving goal conflict; namely, incompatible ES processes verses mandated business processes. End Users can choose to resolve this tension by creating new linkages to patch over deficiencies in the ES by building a FIS to keep the business processes flowing. Alternatively, either they utilise non-IT mechanisms to work around deficiencies, or if they have access to sufficient transformative resources simply refuse to use the ES.

A particular type of workaround that is interest to both Alter (2014) and ourselves is the Feral Information System (FIS). An FIS is defined as a workaround designed to achieve certain requirements using any information technology tool that an End User employs in conjunction with, or instead of the mandated Information System. In this paper, we introduce an operational point of view to satisfy two of the problems Alter introduced. Firstly, we present a workaround in the form of an FIS in situ in a major utility company from the workplace's point of view. Second, we seek to theorise workarounds further as outlined in the future research about workarounds section provided by Alter (2014, pp1060), namely by “ ... *starting from other underlying*

theories". We have taken up Alter's suggestion by exploring FIS from the alternative theoretical standpoint of structuration theory and socio-materiality and through the lens of FIS creation in the above-mentioned utility company.

Businesses seek to maximize the returns on the capital outlays. The use of Information Technology is no different. We hold the view that firms do not care about Information Technology *per se*. Firms care about results, which is to deliver ever-increasing profits and productivity. It is our assessment that the presence of an FIS is an indication that there are inadequacies along the boundary between business workflow and the sanctioned ES that is hindering productivity. In turn, this is causing End Users to resort to other tools and workarounds. Such circumstances are generally a double investment in time and money, often for a resultant "make do" solution. Our view is that, at times, the development of an FIS is justified. Other times, it is not.

This paper has the following structure. It starts with an overview of Feral Information Systems, and positions FIS in relation to Shadow Systems and Workarounds. Next, we touch on underlying theories including Structuration Theory and Five Roles of Information Systems that informed our Research Objectives. Then we touch on our research methodology, data acquired, and our analysis. Finally, we discuss the implications of our research.

What is a Feral Information System?


As mentioned earlier, a Feral Information System as any IT tool or workaround that the End User employs instead of the mandated Information System. We do not restrict the term FIS to just shrink-wrapped software (like desktop spreadsheets and databases). Though such FIS are in the majority, we have also observed FIS as standalone applications written in C, C++, Java, Python, plus a combination of Active Server Page (server) with JavaScript (desktop client). We consider Shadow Systems as a subset of FIS. As a general comment, we do not consider workarounds as FIS, unless it involves an IT tool that is employed instead of the mandated ES. That said; we consider an FIS as steps beyond simple ES rejection.

A literature search into this topic is somewhat frustrated by a drift in the naming conventions that various researchers have applied over the last 30 years. The earliest reference on the term Shadow System in literature is from a 1980 investigation into subterfuge methods to achieve cross-border data exfiltration on mainframe computers (Turn, 1980). Some literature applies the label of Shadow Systems to any End User Developed applications, often with negative connotations. Other various definitions of Shadow Systems include software applications that was not developed or controlled by the firm's central IT department (Zimmermann et al., 2014). Others describe a Shadow System more in terms of a locally developed "bolt on" solution to overcome inadequacies in the sanctioned ES (Lyytinen and Newman, 2014, Stein et al., 2013, Györy et al., 2012, Behrens, 2009), legacy systems including spreadsheets that remained in use despite a newer system being available (Boudreau and Robey, 2005), or to act as an off-line local data store than was more accessible than the ES and occasionally synchronised back to the ES (Berente, 2012). Selander & Henfridsson's (2012) study on cynicism towards Enterprise Resource Planning (ERP), while mentioning in passing the use of a parallel system, is silent on whether the End Users extended themselves to build other alternate systems. Confusingly, the label of "workarounds" was occasionally applied to not only cover what others above had described as Shadow Systems, but to also cover changes in access profiles, reappropriating data fields for data classification, or abusing administrative privileges (Ignatiadis and Nandhakumar, 2009, Petrides et al., 2004).

Current research into Shadow Systems and Workarounds generally fails to acknowledge the body of research in the 1980's and 1990's into End User Computing/Development (EUC/EUD) that covered remarkably similar matters. Back then, local managers were expressing dissatisfaction with the IT Department's inability to keep pace with rapidly evolving business requirements. In return, the IT Department were disturbed about the proliferation of EUD reports and applications. What today we call Feral Information Systems (and subsets called Shadow Systems) clearly existed on the mainframe back in the 1970's (McLean, 1979, Rockart and Flannery, 1981). The arrival of desktop computing only exacerbated the matter. End Users increasingly turned to desktop computers to resolve pressing information needs (Alavi, 1985, Huff et al., 1988, McLean et al., 1993). Recent research

suggests that End User developed IT tools are alive and well, with two-thirds of IT managers noting their existence (Chejfec, 2012). It appears then, that despite 35 years of development time and countless billions of dollars in sunk costs, there are, at times, still considerable gaps between what ES are delivering, and what the End Users need to complete prescribed tasks.

The conceptual framework with existing literature into Shadow Systems and End User Computing is too narrow, insomuch that it assumes that End Users developing their own tools is an issue that starts and stops with Information Technology. End Users - that is scientists, engineers, machinists, etc. - have been modifying existing tools and innovating new tools, for centuries. Most of this in-house development is conducted initially to satisfy the End User's immediate needs (Von Hippel, 2005, Von Hippel, 1988). When dealing with sticky knowledge, End Users can often modify and develop at significantly lower cost than the manufacturers of commercial software (Von Hippel, 2007). We agree with Orlikowski (1992) when she says that workers appropriate and use technology in diverse ways, and there are often heterogeneous outcomes at the organisation and individual levels.

Most large organisations have installed an Enterprise System (ES). Yet, the success rate for an ES is highly variable, even for organisations that share a number of similarities and compete in the same environment. The literature provides some detail on how an organisation responds to a failed implementation (Gattiker and Goodhue, 2005, Botta-Genoulaz et al., 2005, Gattiker, 2002, Nah et al., 2001, Scheer and Habermann, 2000). However, researchers have paid less attention to what happens inside an organisation when some modules of an ES are not realising their design goals. In particular, there is little research how some End Users manage the loss of productivity by building an alternate IS. It is acknowledged that cloud based services such as dropbox, Evernote and Google docs etc. play an important role here and that end users are increasingly using these type of services to help them with their work, however for the purposes of this paper, we are concentrating on traditional, non-cloud based approaches as they were the ones reported in our interviews Therefore this paper aims to explore FIS development from a practitioners point of view within a large organisation. 

Underling Theories

We suspected that some of the problems that we were observing in the workplace had less to do with technology and more to do with organisational matters. If this is the case, we need to turn to other theoretical tools to gain insight. Pozzebon and Pinsonneault (2005) argue that Structuration Theory is “... *a powerful alternative not yet fully explored by students of organisations ...*” Orlikowski and Robey (1991) noted that relationships exist between the “... *information technology, human action, and social structure ..*” as an important element in their research. Recent changes to the theory by Orlikowski towards a socio-material view (see Orlikowski 2010), argues that these processes are more intertwined than previously thought. We agree that they interact, but do not necessarily hold to the view that process entanglement is explainable without understanding the hegemony or social structure. We also agree with the concept that IS are social systems (Staeher, 2008). The literature suggests Structuration Theory may provide insights as ‘*investigation of unacknowledged conditions and unintended consequences (that designers or implementers may not have considered in their plans)*’ (Jones, 2008). The sum of these arguments convinced us to utilise Structuration Theory in our research.

Structuration Theory

Using Giddens (1979) Structuration concepts as a framework, our view is that an ES implementation is more akin to structural transplant than a simple IT project. Before ES implementations, there is usually a rich and complex structure in place at the firm level built upon by human actors over many years. Actors have engaged in recursive feedback between themselves via *social integration* (i.e. the reciprocity between actors) and their *system integration* (i.e. the reciprocity between groups or collectives). Included in the structure are human constructs, like information systems. This *recursiveness* continues across time-space, until someone comes along with sufficient resources that can alter the previous arrangements. A dismissive wave from an ES proponent that these matters are simply “change management” problems is an indicator of a lack of appreciation on their part for the organisation stress associated with replacing an existing system (be that ES, desktop

applications, or even paper based) that is deeply embedded in the structure of the business.

An aspect of Structuration Theory is the concept of how resources are the media of domination and access to a transformative mechanism. Transformative capacity in turn can feed back into the original mode of domination. If human agents have access, they may use authoritative and allocative resources in either modes of domination or transformative capacity on the structure of domination.

In our research, we use the concepts of resource, domination, and transformative capacity to gain insight into the interactions between ES proponents and ES End Users. On one side there are the ES proponents, who are trying to force (dominate) the End User into using the ES. On the other side, there are End Users who have productivity issues with the ES, and are drawing on their modes of domination to parry away the ES proponents.

Five Roles of an Information System

Askenäs (2004, 2000) used Structuration Theory to explore how an IS can become an actor inside an organisation. Her theory allocated five roles that an IS can play. In the context of an ES, we can assume four roles for End Users who use the system, namely: consultant, manipulator, bureaucrat, administrative assistant. There is an additional fifth role where End Users dismiss the IS. Askenäs created the fifth role when she noted how sales representatives were able to draw on their domination over future sales into the business to dismiss the IS. Utilising this dominance, the sales representatives were able to parry away the domination of the ES proponents and alter the state of the proponent's transformative capacity.

From Askenäs' research, we determined that End Users can be divided into one of two groups. Those who have no other options other than to accept the ES as provided, and those with sufficient access to transformative capacity that they can choose to "dismiss" the IS if they so wish. With this in mind, we have reorganized Askenäs five unique roles into two distinct End User modes of operation. End Users either will "submit" (mode 1) to the ES or can "dismiss" the ES (mode 2). We put Askenäs' roles of consultant, manipulator, bureaucrat, and administrative assistance into the "submit" mode of operation, with the dismissed mode standing by itself.

Figure 1 conceptualises our modification of Askenäs' "Five Roles" into two modes of operation.

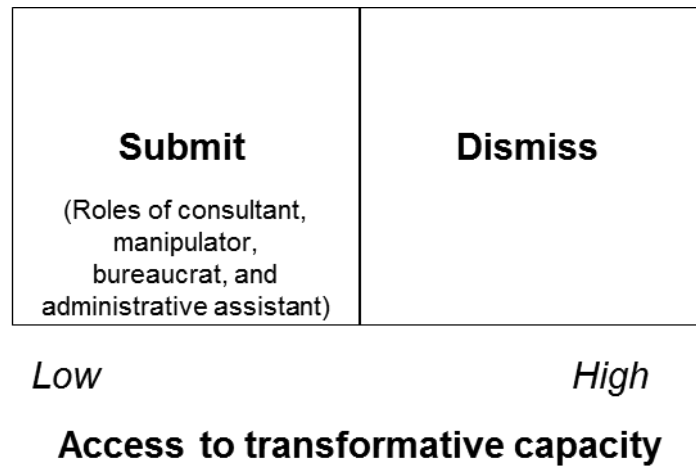


Figure 1 - Modification to Five Roles of an IS, adapted from Askenäs

Askenäs is silent on whether the End Users moved beyond simply dismissing the IS to building an alternate system. We continue the conversation by exploring what happens when an End User take matters into the own hands to develop an alternate IT system – an FIS.

One aspect of Structuration Theory is that individuals have some domination over their own resources and to some degree can influence their course through time-space. The extent of an individual's ability to develop an alternate IT system is heavily dependent on choices they make. This fits within Weber's concepts of *Lebenschancen* (life chances) along with *Lebensführung* (life conduct), as the two basic components of Weber's *Lebensstil* (lifestyles).

An implicit assumption in our research is that not all End Users are equal when it comes to computer skills. At one end of the scale are End Users whom have little desire or little opportunity to acquire skills in computer programming. At the other end of the scale, are End Users/Knowledge Workers who are quite adept at learning a programming language, and see this skill as complementary to their core profession of being a scientist or engineer (Segal, 2007).

Therefore our three Research Objectives in this paper are:

RO1: Determine how End Users acquire the skills to build a FIS.

RO2: Explore how End Users (as knowledgeable agents) appropriate and allocate available resources, be this an ES or FIS, to fulfil demands for information.

RO3: Determine circumstances around agent's deployment of resources as an interposing mechanism to defend the FIS and parry away ES proponents.

Research Methodology

We employed case research as it is flexible and versatile, and particularly when the technical issues are secondary to the organisation under study. Case studies provide a mechanism for academia and practitioners to keep abreast of the rapid changes taking place in organisations and the IT community (Dubé and Paré, 2003). A process of triangulation and corroboration will minimise research bias inherent in single points of view (Yin, 2009). Our triangulation tools included interviews of professionals from the IT Department to provide their views, our direct observations of the ES and FIS in action, and an archive of contemporaneous records from the ES implementation. Further, we adhered to Yin's three principles of data collection; using multiple sources of evidence, store evidence in a case database, and maintain a chain of evidence (Yin, 2009).

The case site is a medium size utility based in Australia. We call this site UTILITY1. It has a strong engineering culture. Internal resources perform the majority of the core work associated with planning, designing, building, and operating the asset. At the time the first named author collected the field data, the ES implementation under study was nearly ten years old. This provided an excellent opportunity to study a system in its mature phase. For this research, we utilised "*special access*" arrangements (Yin, 2009) through industry contacts.

For RO1, we profiled End User skills using three mechanisms. The first mechanism is a catalogue of End User computer skills in using the desktop applications and their ability to write code. Instead of a formal skills test (Compeau and Higgins, 1995) or an independent technical expert (Ko and Myers, 2005), we used End User self-assessment (McCourt Larres et al., 2003) moderated by our observations. The nominated skill sets is then related to our view on the ladder of capability that FIS

developers climb. On the bottom rung of the ladder is a simple spreadsheet, with the rungs near the top being an ability to code in various languages including SQL, Java, C, etc/. The second mechanism is how End Users acquired these skills: structured learning (typical at a tertiary institution), unstructured learning (typically from a workplace colleague), and autodidact (typically off the internet or from hobbyists roots). The third mechanism was the contribution that the formal education process makes to developing End User skills. For this, we sought information about End User's level of academic achievement under the Australian Qualifications Framework (AQF).

For RO2, we sought evidence of the demands for information that the business places on End Users and their first choice preferences to fulfil that demand. Next, the views from End Users and IT Professionals on functional gaps between ES and business processes, and the strategies employed to resolve functional gaps. In addition, we explored End User selection and appropriation of IT tools to build an FIS.

For RO3, we sought evidence on other resources (i.e. resources from a Structuration Theory perspective) that FIS Developers engage with to boost their ability to interpose into circumstances to parry away attempts by ES proponents to foster the ES.

Data and Analysis

RO1 – End User IT Skills and Acquisition

For some FIS Developers, their IT skill base is not much more than sufficient for the proscribed tasks.

“I wouldn't say my IT skills are fantastic, but they're sufficient to do the work that I do and the skills don't go beyond the normal Microsoft type of skills, Word, Excel. They're pretty much it. A little bit of experience in Access Database.” (IC3: Lines 30 – 33)

At the other end of the skills spectrum, some End Users taught themselves how to code in a new language when confronted with a new application or business problem. For example, when IC1 gained access to an engineering application that

used Python as its embedded scripting language, IC1 simply pulled out the instruction manual and worked from there.

“... in fact I have done that, maybe, four times as there are four different languages I’ve learnt, whilst being employed in [company name]... That would include; Java, Python, C++ ...” (IC1: Lines 30 – 33)

Table 1 is a summary of End User skills they have available for deployment to build a FIS. While everyone could use basic functions of a spreadsheet, 50% could not progress beyond using spreadsheet formulas. End Users who had migrated to desktop databases had mainly done so because they had become constrained by the limit of 65,536 rows in Microsoft Excel 2003. Only three End Users had capability with more general-purpose programming languages. The codes for capability are, H – High, M – Medium, L – Low, N – Not Acquired, and U – Unclear.

Interviewee	Spreadsheets	Excel Formula	Excel Macros	Visual Basic	Desktop Database	SQL	C, C++	HTML	Java	Python	Other
IC1	H	H	H	H	H	M	H	H	H	H	H
IC2	M	L	N	N	N	N	N	N	N	N	N
IC3	M	L	N	N	N	N	N	N	N	N	N
IC4	H	H	H	H	M	L	N	N	N	N	N
IC6	M	M	N	N	L	N	N	N	N	N	N
IC8	H	H	H	H	H	L	N	N	N	N	N
IC9	H	H	H	H	H	M	M	M	M	M	H
IC10	H	H	H	H	M	M	N	N	N	N	N
SUP1	H	M	H	H	L	N	N	N	N	N	M
SUP5	M	M	L	L	H	M	M	U	U	M	M

Issues that support the creation of ICT Workarounds

SUP7	M	L	N	N	L	N	N	N	N	N	N
SUP8	M	N	N	N	L	L	N	N	N	N	N

Table 1 - End User Application/Coding Skills

End Users acquired the IT skills to build a Feral Information System from a variety of sources. One Developer constructed an FIS out of the knowledge obtained from long-term exposure to the IT professionals who installed and maintained the ES.

“Well, I guess you could call it a necessity that came out of a personal interest ... obviously, being [an End User] on IT [ES implementation] projects, you start seeing the back end of these systems and you're obviously trying to help the business utilise them better. So, the skills you pick up are out of that want of, well, how do I get the information that I need to make things better? So, gaining any skills that I've got and - was out of a personal interest, I guess but out of a need of the business.” (IC10: Lines 61 – 67)

Others had autodidact IT skills based on hobbyist experiences.

“I've always been interested in programming and building things, ever since the TRS80 we had as a kid. So I've programmed in BASIC, learned machine code on a Commodore 64, which I then applied to microcontrollers. I had used VB for DOS in a summer job, and other than that the rest of my programming's been microcontrollers and DSPs (Digital Signalling Processors). So the idea - my philosophy is that if it can be automated and be done by a computer, why should I tax my brain to do it. So I'm all for easy.” (IC9: Lines 127 – 138)

Table 2 provides a summary of evidence that we obtained on the sources of skills to build a FIS.

ID	Structured Learning	Unstructured learning	Autodidact
IC1	High	High	High
IC2	Nil	Low	Nil
IC3	Not ascertained	Low	Low

Issues that support the creation of ICT Workarounds

ID	Structured Learning	Unstructured learning	Autodidact
IC4	Not ascertained	Medium	High
IC6	Not ascertained	Medium	Medium
IC8	Not ascertained	Medium	High
IC9	High	High	High
IC10	High	High	High
SUP1	High	High	Not ascertained
SUP5	High	Not ascertained	Not ascertained
SUP7	Not ascertained	Not ascertained	Not ascertained
SUP8	Not ascertained	High	Medium

Table 2 - Sources of Skill Acquisition

Table 3 lists interviewee's qualifications obtained under the Australian Qualifications Framework. The code SSCE indicates that interviewee has obtained a Senior Secondary Certificate of Education. The codes AQF indicate conferral of formal qualifications at that level. AQF3 is typically trade qualifications. AQF6 is typically Associate degree. AQF7 is Bachelor Degree. AQF8 is an Honours or Graduate Diploma. AQF9 is Masters Degree, with AQF10 Doctoral Degree. A double tick indicates two academic qualifications at the level (e.g. a double degree).

Interviewee	SSCE	AQF3	AQF4	AQF5	AQF6	AQF7	AQF8	AQF9	AQF10
IC1	✓					✓		✓	
IC2	✓								
IC3	✓			✓					
IC4	✓					✓✓	✓		
IC6	✓	✓			✓				
IC8	✓	✓			✓				
IC9	✓					✓	✓	✓	✓
IC10	✓	✓			✓				

Issues that support the creation of ICT Workarounds

Interviewee	SSCE	AQF3	AQF4	AQF5	AQF6	AQF7	AQF8	AQF9	AQF10
SUP1	✓					✓		✓	
SUP5	✓					✓	✓		
SUP7	✓					✓	✓		
SUP8	✓	✓			✓	✓			
EX1	✓					✓	✓		
IT1	✓					✓		✓	
IT2	✓					✓	✓	✓	
IT3	✓								
IT4	✓					✓			
IT5	✓				✓				
IT6	✓					✓	✓		
IT7	✓	✓				✓		✓	
IT8	✓					✓			

Table 3 - Matrix of interviewees and formal qualifications

End Users applied a wide spectrum of skills to build a FIS. It ranged from rudimentary skills used to develop a local spreadsheet through to highly advanced skills that combined multiple IT approaches (e.g. packet sniffing plus SQL plus asynchronous JavaScript). The entry barrier to a basic FIS is low. However, more sophisticated FIS drew on ever more complex IT skills. End Users can acquire FIS building IT skills through all three nominated pathways: autodidact, unstructured learning, and structured learning. The simplest FIS we observed in this study were a result of unstructured learning at the workplace. As the level of formal qualification rose, so too did the capabilities of the FIS. However, it is hard to separate out cause and effect between formal qualifications and FIS development capabilities. What is more apparent is that the builders of simple FIS drew on only one mechanism of skill acquisition. As the FIS-builders drew across diverse skill acquisition pathways, so too did the resultant FIS grow in capability and sophistication.

RO2 – End User Allocation of Resources

The demand for information was diverse. Common themes noted are the gap between ES functionality and business requirements, and that the problem could be broadly categorised as either a reporting matter or a forecasting matter. The business impact of the demands for information varied across a broad continuum of needs: from seemingly trivial reporting needs through to resource planning for the whole of business.

FIS Developers exhibited a strong preference to use the ES. Typical End User views were:

“If it is available from a corporate system; I’d go down that route. Second route that I go down is to obviously follow the corporate process off inquiring with [IT Department] to see what the process would be to obtain that information.” (IC1: Lines 43 – 45)

“I’d love the data to come out in a nice, useful, pretty way, and hopefully [names proposed new reporting system] is going to be able to do that.” (IC4: Lines 361 – 362)

“We’ve got some really good tools in there [in the ES] where we use really well.” (IC6: Lines 149 – 150)

All FIS Developers and Supervisors experienced frustration with having ES data available in a usable form.

“Reports, on the other hand, I’ve heard people waiting two years, which seem a bit excessive...” (IC10: Lines 284 – 285).

“When the error was found – the [business custodian] said, “I’ll fix it. I’ll go and get the other existing report changed.” So this - you would expect this is high priority of the organisation, that was at the end of March and initially we were told 13 April it’ll be released and we’re now at 30 March, almost a full year later! It’s still never been released.” (SUP8: Lines 384 – 389).

“But the corporate systems, you didn't even bother wasting your time talking to IT. You can just write “NO!” on your own whiteboard, and save yourself a week's work.” (IC9: Lines 341 – 348).

The IT Professionals held similar views on issues associated with ES reporting systems.

“Reporting's been a big black hole for IT for a long time. If you looked at the inventory of reports over a period of time that you've run, my experience is you'd be lucky to see 10 per cent of those reports were actually in use and the remaining 90 per cent were legacy. So reporting is very expensive. A lot of IT organisations try to get out of the reporting game and push it back to users. I think vendors were trying to sell it in that way as well.” (IT7: Lines 261 – 268).

End User's continual and simmering frustration to access the data contained inside the ES - for legitimate business purposes we might add - can drive some surprising behaviours at times. One skilful End User resorted to packet sniffing to get access to ES data. IC1 installed Wireshark, a packet sniffer application, on the corporate computer. At that time, the desktop applications communicated with the corporate databases over TCP/IP in plain text. By using Wireshark, IC1 was able to capture usernames and passwords to connect to the various databases. More importantly, IC1 was able to observe the various SQL statements to decode the structure of the tables. When the researcher questioned why IC1 went down the packet-sniffing route, IC1 had this to say,

“Yeah, so, first of all I should just say, my choice, my personal preference would be not to packet sniff, I actually think that, as a corporation it would do us a great deal of good to actually have a little bit more openness behind our corporate reporting. So, not just document the output of the report but also document the methodology by which the report is produced. Such that [it is] open to people checking that it actually produces the numbers that they need, and also, it would enable people to take that query and adapt it for themselves. I personally think that packet sniffing shouldn't be needed ...

So, I guess, that is a fundamental philosophy that I disagree with about how [IT Department] is run. But as far as how packet sniffing works, I just

download an open source product, such as Wireshark, and that enables me to monitor packets being sent back and forth over the network. I then run a query from inside a corporate package. It will often have to send away a query to a database server to be run. And, on its way over the network cable I can – over the network connection – I can intercept it and inspect the SQL that was used.” (IC1: Lines 354 – 356)

It would be a mistake to assume that IC1 did all of this on his own undertaking. IC1 received strong encouragement from his colleagues and supervisors. As IC1 notes,

“So, existing in that environment for long enough, people start to accept that they are not going to be able to achieve the things they require. The minute they are exposed to someone with the technical capability to achieve those things, they clearly jump at it. It is clearly like I said before, if all those circumstances do happen, if they can, people will find a way to do these things. When it comes to my supervisors, managers, often times they might not have the capability themselves. So, it is a question of if someone happens ... happens to join their team who does have the capabilities, they will often leverage them because that’s the only way they can get what they need to get done, done.” (IC1: Lines 421 – 428)

ES can generate additional costs to the business that is well outside the immediate problem at hand. SUP8 had this to say about the concept of ES being a single source of truth.

“So the fact that you have complete opposite views out of what I can only presume to be the same data set - and this is all similar data sets, it's all coming out of the same system. It just goes to show the fallibility of the [concept of a] ‘single source of the truth’ [being the ES] and we've passed this back to the [Reporting Department] and said whatever you're doing we're not sure that you actually got it right...” (SUP8: Lines 227 - 234).

While at first glance, a simple reporting error may seem a rather trivial matter, SUP8 detailed the additional workload it created for the Department. There is also an internal political element as the one Business Division generates the report. The Reporting Department sends it up their chain of command. It then travels across the

top at the Senior Executive level, where a discussion occurs that is unfavourable to one Executive. Finally, the report travels down the chain of command in another Business Division. SUP8 noted the impact on the business as a whole. In particular, the error in this report unnecessary distraction and needless consumption of managerial time.

“It gets a whole lot of focus but it's noise. It creates conversations in the management of the organisation which costs us a whole lot of time and energy for no purpose.” (SUP8: Lines 239 - 241).

The FIS that SUP8 was discussing is an example of how some FIS builders have accumulated and can wield considerable resources to defend the existence of the FIS. The accumulated resources include:

- A. knowledge of how to export data from the Enterprise System;
- B. skill to build a spreadsheet or desktop database to store the exfiltrated data;
- C. capability to develop queries on the local data set, and importantly;
- D. managerial sponsorship, sometimes at a very high level in the organisation, to expend the necessary labour to develop and maintain the FIS

Vendors often tout that the advantage of ES is that they are a common data repository, the so-called single source of truth. However, this common data repository is also a weakness, especially when a well-intentioned but poorly supervised employee is altering key data. Part of IC2 justification for the local FIS was its use as an auditing and change log tool. IC2 had this to say about the activities of some work colleagues.

“... Holy crap. That's the approved amount on that [managerial approval], that's what was approved, you don't go in and add 15 per cent to that. You don't go in and change all those project managers without looking at the rest of the information. There's no start date, there's no end date. Project manager's wrong, the workgroup no longer exists...”

It is a data cleansing issue. It is a constant data cleansing issue because the people do not take ownership of their own things. People – we're in such a big

organisation. Taking ownership of something is actually frowned on, I think.”

(IC2: Lines 1025 – 1044)

A mere glance at the Table 4 indicates there is no ‘one common mechanism’ that End Users deploy to build and maintain a FIS. Rather, it is a bricolage of approaches (Alter, 2014). End Users make do with the resources they have available. End Users appear to have a behaviour where they stop development when the solution reached their either their technical limits or a ‘make do’ limit. The ‘make do’ limit implies the End User has determined that additional investment in time to further develop the system exceeds the payback in a future reduction in labour.

As a general statement, most supervisors are aware of the development and use of a FIS in their department. Some supervisors were very active in the ongoing usage of the FIS. There are a few exceptions to the previous comment where the supervisor was not aware that the FIS existed (e.g. FIS2 and FIS6) – see table 4. For most FIS, the supervisor’s involvement assists with providing resources (mainly discretionary time) for the End User to develop and maintain the FIS. In return, the FIS boosts local productivity for the department.

Issues that support the creation of ICT Workarounds

Resource	FIS1	FIS2	FIS3	FIS4	FIS5	FIS6	FIS7	FIS8	FIS9	FIS10
Basic spreadsheet		✓				✓	✓			
Complex spreadsheet			✓	✓			✓		✓	✓
Desktop database				✓	✓		✓	✓		✓
Uses SQL	✓								✓	✓
Other advanced IT tool	✓								✓	
CSV data extract from ES			✓	✓			✓	✓		✓
ODBC data extract from ES	✓								✓	✓
Hand access to data		✓			✓	✓				
Supervisors knows of FIS	✓		✓	✓	✓		✓	✓	✓	✓
ES proponents know of FIS	✓		✓	✓	✓			✓	✓	✓
Used for reporting		✓	✓	✓	✓	✓		✓	✓	✓
Used for forecasting	✓						✓			✓
Mashes data	✓	✓	✓			✓	✓			✓

Table 4 - Summary results from RO2

RO3 – Ability to Harvest Resources to Interpose

One theme that we concluded from the data was dyad and triad relationships involving the FIS. The primary dyad is the End User and the Feral Information System. This may or may not extend to form a triad of End User, Feral Information System, and the immediate Supervisor. We examined perceptions in the relationship between the dyad/triad and the IT Department and observed what happens when there is perceived conflict between the Supervisor and the IT Department.

Specifically, how and when the Supervisor may, or may not, interpose themselves to protecting the dyad. This leads onto the next theme of whether or not the dyad/triad believe they can ignore the IT Department. Finally, we briefly touch on the topics of End User perceptions of ES productivity benefits and job security.

IC1 had this to say about Supervisors involvement in FIS development.

“Yes, every single one of my supervisors has, been aware of, I always been careful to explain to them what I was doing. Such that, and I also clearly explained to them that it was them, in fact, that was taking the risks associated with potentially developing a Feral Information System or the like. However, none of them have every expressed, any problems with that. In fact, they have encouraged it when I have reached a point where I have personally; I think the better approach would be to go down the corporate method. They’ve actually push for the sake of productivity to do more and more feral development, I guess.” (IC1: Lines 407 – 417)

Whereas the Supervisor appears to be oblivious of IC6 using an FIS to provide data.

“... no one's ever asked me where do I get it [the data] from. Seriously! No one's ever asked me.” IC6: Lines 364 – 365)

IC9, like IC1, was a highly skilled knowledge worker. IC9 was often capable of working around technical rules imposed by the IT Department. At times, IC9 was encouraged to do so by line Supervisors. IC9 had this to say about resolving possible conflict:

“No, I just did it... As long as it's not illegal and breaking any laws, I don't have a problem with being pragmatic about developing a system to do what's needed.” (IC9: Lines 496 – 500)

Being pragmatic about solving the immediate, often pressing, business problems is a key motivator to local use of Information Technology. We noted two patterns emerge in the evidence of End User behaviours. Some openly display their activities to colleagues in the IT Department. Others keep their behaviours with FIS hidden. Although, it is interesting to note that even the most open End Users often adopt some degree of circumspection at times to achieve what the outcome they are chasing. While the majority of Interviewees felt they could ignore the wishes of the IT Department, a significant number felt they could not. While we have categorised the responses into simple yes/no answers, in practice it is somewhat more complex. For example, IC10 was prepared to skirt right up to the edge of the ‘no’ line. While IC1, arguably the person who pushed the boundaries the most, clearly had limits beyond which he was not prepared to go. We conclude that most interviewees felt they

possessed sufficient resources to be able to ignore the IT Department, and were prepared to call in backup support from their chain of command if they believed they had a justifiable case. It is important to note that is an End User perception of the circumstances.

On rational put forward in the literature (Markus, 1983, Marakas and Hornik, 1996) is some End Users passively reject change associated with ES implementation. We were curious if concerns over job security were a feature in the development and use of Feral Information Systems, and included a question about this in the interview.

“Fine, as long as we continue to rely on systems like that I’ll always have a job.” (IC1: Lines 496 – 498)

IC2 and IC3 expressed similar sentiments.

“No. Not at all. It’s just another program for me to learn... I’ve probably learnt - in the last 20 years I’ve probably mastered 50 in-house programs. So...[shrugs shoulders]” (IC2: Lines 828 – 831)

“Oh it had no impact whatsoever as far as job security goes because I think [names ES] did absolutely nothing to improve our efficiency or reduce manpower, had no effect whatsoever. (IC3: Lines 306 – 307)

Not one of the interviewees expressed any concerns about the ES affecting their job security. The general view was that while the theory is that ES reduces headcount, the reality is ES generate additional workload for the End User.

Resource	FIS1	FIS2	FIS3	FIS4	FIS5	FIS6	FIS7	FIS8	FIS9	FIS10
Can ignore IT Department	Y	N	N	Y	Y	Y	Y	N	Y	N
ES impacts job security	N	N	N	N	N	N	N	N	N	N
End User likes ES	Y	Y	N	N	N	Y	Y	Y	Y	Y
ES improves productivity	Y	Y	N	N	N	N	Y	N	N	Y

Table 5 - Summary results from RO3

Discussion

An Edgeworth box and Production Possibilities Frontier (PPF) can explain the micro economic behaviours of End Users when confronted with an ES that generates additional workload. Pre-ES implementation, End Users divided their allotted time between using the ES and aggregate time on tasks that generate a profit for the business. While a new ES can increase the time End Users spend using the system, the theory is the ES simultaneously pushes the organisation's PPF outwards, thereby increasing End User productivity. However, if there is misfit between the ES and required business practices, then the ES is forcing the End User to allocate more time to interfacing with the ES. In turn, this pushes the End User along the PPF curve, resulting in a reduction in aggregate time the End User spends working on profit generating tasks. While this may seem obvious, literature has largely ignored micro economic influences as drivers for End User responses, and has tended to concentrate on social theories to rationalise behaviours.

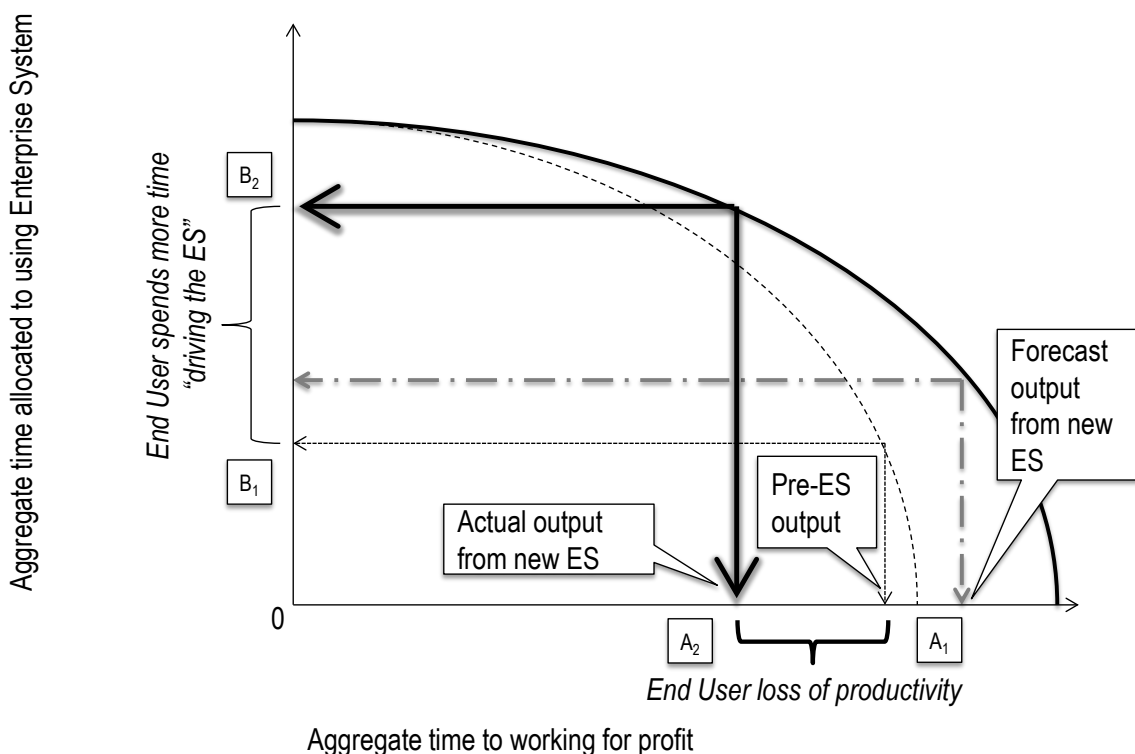


Figure 2 - PPF curve for excessive time using the ES

Further, we suggest that End User may respond to a loss of production function by adopting one of four possible Modes of Operation. Which mode they choose is

largely dependent on their access to transformative capacity using interposable resources and their ability to develop their own IT tools. Those End Users with low access both have no other option than to *submit* to the ES. End Users with sufficient access to interposable resources, have the option to *dismiss* the ES and thereby throwing the problem back into the lap of the ES proponents to solve. Some End Users, who have an ability to develop an alternative IT tool but lack sufficient interposing resources, will build a system that they keep *hidden* from ES proponents. While literature has discussed such constructs as shadow systems, literature had overlooked the fourth variant that we discuss: the *defiant* system. End Users who have access to sufficient interposing resources and skills to build IT tools may elect to construct defiant systems. Given the resources with transformative capacity that are sponsoring defiant systems, there is little that ES proponents can do about them. Figure 3 shows the relationship between these four Modes of Operation, access to transformative capacity, and ability to develop alternate IT systems. It also shows the positioning of Modes of Operation against existing theories of Five Roles of an IS, Shadow Systems, and Workarounds.

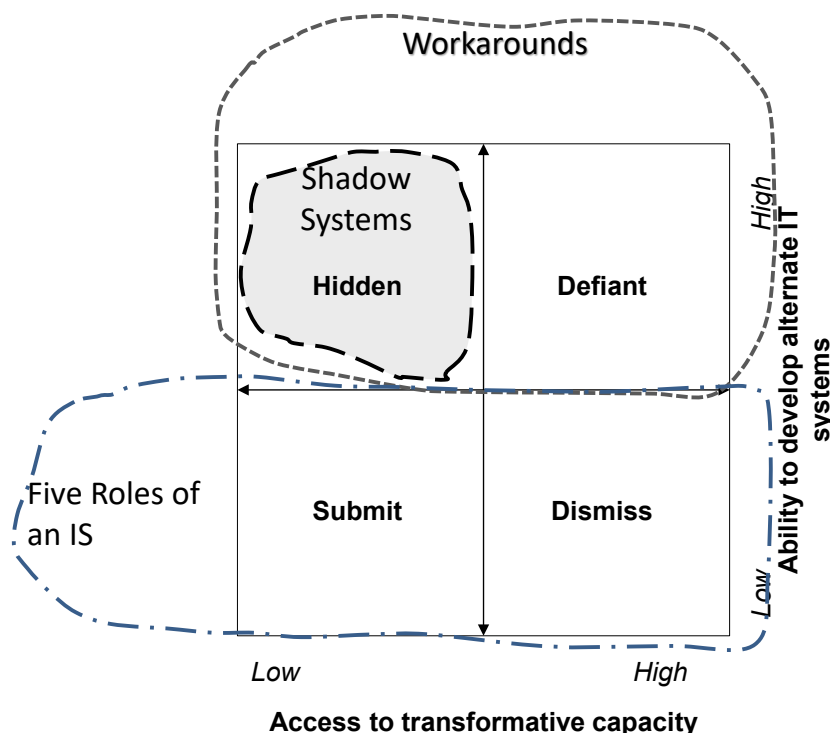


Figure 3 - Placement of theories

Implications

This study demonstrates that when ES's fail, there is an underlying tendency for workers to intuitively fill the gaps. One prerequisite are cost transfers onto End Users by both internal ES proponents (e.g. ES implementation team) and external ES proponents (e.g. Vendors and Consultants).

FIS are an innovative solution developed during a period of crisis for the End User. The crisis occurs when ES proponents corner the End User into resolving goal conflict; namely, incompatible ES baked-in processes verses mandated business processes. A facet that was a surprise to us is the interposing role of Supervisors (of FIS Developers). Supervisors are often an important resource for building and defending the FIS. They can add additional (in Structuration terminology) "resources" available to interpose into the problem that FIS Developers are attempting to solve. Supervisors have access to sufficient modes of domination they can effectively parrying away the capability of ES proponents to shut down an FIS.

Current research into workarounds identifies FIS as a simple patch. We theorise that these are not merely patches, but extensions of the ES that End Users construct to improve operational efficiency and to keep the business processes flowing. Alternatively, (as observed by others) they utilise non-IT mechanisms to workaround deficiencies. Other open options are available to End Users with sufficient transformative resources is to refuse to use the ES. Refusal throws the problem back into the lap of the ES proponents. For a business struggling with poor ES fit, the worst-case alternative to an FIS is for End Users to follow ES proponent's instructions.

Instead of being passive-aggressive, FIS builders take a pragmatic approach to reappropriate available technology to fix a problem. Their IT skill, sometimes deliberately enhanced during the building process, determines the FIS quality and usability. Some FIS builders, particularly those with mathematical and language skills from allied disciplines of science and engineering, have IT skills that can easily exceed the average IT professionals. That said; the skill barrier to building a rudimentary FIS is remarkably low. Further, we see the entry barrier to FIS continuing to fall as the IT tools become more readily accessible, user friendly, and

takes on differing forms (e.g. cloud based solutions succeeding over desktop IT tools).

We suggesting that punishing FIS builders is counterproductive, as these employees are amongst the more proactive and committed business problem solvers. FIS are a symptom of an underlying business problem, not the cause. Although, we agree that if the number of FIS gets out of hand it will be highly problematic for the host organisation. FIS will naturally dissipate if remedial work makes good the fit between ES and business needs. If fixing the ES is not achievable, then Supervisors, specialists from the IT Department, and End Users should work together to make the FIS provide acceptable levels of quality and reliability.

This contributes to Alter's (2013) work in that it begins to provide a theoretical structuring and assessment of why people actually create these FIS in the first place. We provide a theoretical base for further explanation of workarounds as a process of 'creative' behaviour or adaption to disjointed impositions. We argue that workarounds do not give enough theoretical insight into the 'drivers' of behaviour or the modes of operation. Due to this, we cannot effectively work practically to understand them, and subsequently they are under theorized in the literature. This paper uncovers the 'modes' of operations that lead to feral information systems and conceptualises them as part of a lifestyle choice made willingly by participants in order to 'fix' broken organisational linkages through poor ES implementations.

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