OSS Adoption in South Africa: Applying the TOE Model to a Case Study

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Abstract. This paper presents a case study on the factors that influence the initial adoption of Open Source Software (OSS) in a large South African organization when implementing an OSS PBX platform. The theoretical foundation for this research draws on a number of academic frameworks and models, thus not only providing a practical illustration but also validating their usefulness in guiding OSS adoption.

1   Introduction

This paper explores the adoption of OSS in South Africa with a view to finding out how a South African (SA) company went about adopting OSS, uncovering what factors influenced the adoption and contributed to its sustainability in the post-adoption period, and investigating how supportive theoretical OSS models are of successful adoption. The OSS adoption was ascertained within the Technology, Organisation and Environment (TOE) framework, with factors drawn from a number of other OSS models as discussed in below.

The research hopefully offers practical insights to organisations who are considering adopting OSS. Researchers may find that it sheds light on the usefulness of some theoretical frameworks and models.

2   Theoretical Framework

The theoretical framework was beased on the Technology, Organisational and Environmental (TOE) framework, which identifies three contexts in which an organisation functions and therefore may influence its ability to adopt technology and affect the process by which it accepts [12] and implements a new technology [17]. These contextual factors also influence the organisation's intent to adopt an innovation, and affect its assimilation process as well as the impact of the innovation on organisational performance [17].

The **technological** context refers to the internal and external technologies available to the organisation which have a bearing on its productivity [12] and encompasses existing technologies, both those in use within the organisation and the

relevant technologies the organisation can draw on externally [18]. They include elements of open source maturity and technology readiness. Dedrick & West [4] consider five technological factors, namely compatibility, complexity, relative advantage, trialability and observability. They identify the three most common variables linked to technology adoption as compatibility with existing technologies, relative advantage over current technologies and with complexity negatively influencing adoption. Relative advantage is the measure of how much of an improvement the new technology is relative to the existing one and is primarily measured in terms of cost and reliability [18]. The software cost and risk model determines the cost and the risks of using open source [9]. Failure to optimally manage the potential risks and rewards of open source will put IT organisations at an increasingly serious risk in the coming years [5].

The **organisational** context is characterised by a few descriptive measures, i.e. scope, size of the organisation and the slack resources available internally. Organisations have different competitive positions and roles for IT, and a high level of IT intensity has been shown to be proportional to open source adoption [11]. The innovation orientation of an organisation is related to the timing of adoption and the triggers prompts pertinent to adoption decision [3]. The centrality of IT to the business strategy is core to the willingness of the organisation to adopt open source [4]. Choice set and selection occur as a response to software adoption policy, but more importantly arise within the application context. This context exhibits the strategic significance of the specified system and consequently the equivalent weighted value for features, risk, cost and available products where the predilection of the buyer is restricted by a limited number of available choices [11].

The **environmental** context refers to the arena in which the organisation operates and conducts its business [17]. The organisation is influenced by its competitors and by the industry itself [12]. Environmental factors encompass factors such as rivalry and relations with buyers and suppliers [18]. A regionally available appropriate skill set reduces the time investment and the cost of using open source [9], although few certification programs exist for computer and network support professionals wanting to specialise in open source software [1]. A useful conceptual framework for exploring the OSS skills is the Open Source Skills and Risk Tolerance model. This ascertains the capacity of the organisation to handle the risks intrinsic in open source adoption and produces a risk tolerance plan and profile [9]. However, developer skills may be improved by the intellectual challenge of contributing to software development when they are granted access to source code [2]. Other barriers to the successful adoption of open source are the lack of resources and/or the availability of external technological resources as well as the lack of compatibility with current technologies and skill [10].

3 Research Methodology

In this research, a deductive, explanatory and qualitative research approach was taken. A qualitative case study approach was chosen because of the interdependence between variables and the non-measurability/intrinsic complexity of some of the variables. The aim is to provide richer and more subtle explanations than statistics can provide. The case study was a recent implementation of an open source PBX system, Asterisk, in one of the leading and largest medical health administrators in South Africa. The supporting data for the case study comes from semi-structured interviews with nine key decision makers within the organization: the Managing Director (Scheme Administration), MD (IT), Head of IT Infrastructure, Head of Telephony Solutions, the enterprise architect, the principal specialist, the senior manager, the software architect and the solutions architect in charge of the project.

4 Applying the TOE Model to the Adoption of an OSS PBX Platform in a South African Financial Services Company

The case takes place in one of the largest medical aid administrators in South Africa, with more than 2500 employees. They administer close to one million members and are one of the leaders in their field. They were faced with the important and high-risk decision to replace their PBX system in their 800-seat call centre. Negotiations with a number of proprietary vendors ensued, including their preferred communications provider, but no proprietary vendor could promise them the tight delivery times or required customizations. At that stage, they investigated Asterisk, an open source PBX system. The system was piloted, extensively customized and successfully put in production by the end of 2008. The case study was analyzed using the TOE framework and demonstrates the empirical validity and relevance of the factors outlined above.

4.1 Technology factors

Access to source code – The ability to access the source code was a key positive factor mentioned by most respondents in the case study: *"The product itself is very basic, we're building around that to create exactly what we want"; "the ability to customize";* and *"to be able to be creative"* (Developer). They develop, maintain and support the OSS internally and they additionally post fixes for Asterisk PBX source code back into the community.

Complexity – Although the skill set to develop customized solutions around OSS products may require additional resources "*the skills that you deploy to customize the solutions need to be a lot more experienced*", the software architect did not perceive OSS products to be intrinsically more complex: "*they are not more complex, it depends what level you look at it. At a source code level, I don't think they are more*

complicated." On the other hand, the head of Telephony opined that OSS may often lack a user-friendly GUI to administer it: "*the only complexity that OSS PBXs introduce is that they don't have the easy or simplified configuration interfaces like proprietary PBXs*".

Cost – The cost factor was never the initial key consideration. The major drives for the adoption were the quick deployment capability and the flexibility the solution provided: "*the cost factor over time is not a huge factor, for me it was about getting a solution that can deal with the growth of the business*" (MD of Schemes). In fact, management was nuanced about distinguishing between the zero licensing costs and the Total Cost of Ownership "*Nothing in life is free. You got to have somebody who is supporting it … a Linux person, an Asterisk person… It's got a different cost of ownership model but, on the whole, in the end, as the maturity of the product grows, it does tend towards to being cheaper over time*" (MD of IT). However, the cost savings were significant: "*expensive carrier grade switches don't differ substantially in functionality to what Asterisk can do.*" An internal cost benefit analysis revealed a saving of OSS over proprietary in the region of R30 million (about US$ 4 million) over the 36 month budgeting period.

Compatibility – Because of the existence of standards bodies, compatibility was assured: "*in the environment, they work with the de facto standards anyway*" (MD of IT). Critical to building an open source telephony platform was the fact that telephony equipment is produced to open telephony standards and the ability to source non-proprietary telephony components: "*If that [standard peripheral devices] didn't exist, open source for this specific application would never have been an option.*" (Head of Telephony Solutions)

Trialability – This was important as indicated by the IT Infrastructure Manager: "*We started playing with it (OSS PBX), and we realized that it was one hell of a product... that actually, this could work for us as an organization…*"

Reliability – Although initially there were stability problems, in the end they achieved a stable solution: "*you just have to keep working at it to achieve the same amount of reliability*" (Developer).

Maturity –Digium's commercialization of Asterisk PBX support was an important influencing factor. The fact that a third party organization had built a business around packaging and supporting the OSS solution signalled the broader market acceptance and continuity: "*There is a 'keep alive' of the product [since] Digium has built a business around Asterisk. [...] This tells me Asterisk will not drift sideways.*" (MD IT) This was in spite of the fact that they did not use nor intend to use Digium's services.

In this particular case study, some of the other technology factors (e.g. potential project forking, security issues and observability) did not seem to play a role.

4.2   Organisational factors

Firm context – Being in the highly competitive financial services industry, the organization is very IT intensive. One of the key differentiating factors in the

industry is customer service and the ability to deliver new products and services quickly. The two MDs put it as follows: "*Technology plays a big role in [our] positioning [for competitive advantage]*" and "*Technology is very dominant in our strategic thinking*". However, the Senior Manager confirmed that the specific decision to go for Asterisk was not driven by competitive pressure explicitly.

Centrality of IT – IT and the ICT infrastructure is critical to the day-to-day functioning of the business. The communications infrastructure in particular is a critical business infrastructure component, so the replacement decision had a high risk profile. *"... when the PBX is down, you are dead ... it is the most business critical along the lines of our applications ..."* (Head of IT Infrastructure).

Open Source attitudes – The organization uses a combination of OSS and commercial applications so there were no critical attitudes to content with: "*I don't think they had an attitude about Open Source Software. I don't think they were pro or against it*" (Head of IT Infrastructure).

Standards attitudes – This is an important consideration in favour of open source: "*I am very comfortable with [open source], they don't just change standards. I mean if you are busy using an API, they are not all of a sudden going to make it incompatible, that is something that happens with Microsoft*" (Solutions Architect).

Boundary spanners – These are very important. A number of staff had already gained positive prior experience with OSS implementations. The OSS PBX was introduced to the company by an external telephony consultant, who also supported the solution in the initial deployment phase.

4.3 Environmental factors

Vendor Support – Although the existence of an independent support service provider is an important consideration in establishing product maturity, it is not a factor in procuring actual support: "*[Digium provides] that enterprise level of support. But we still do it ourselves*" (developer).

OSS Support – The need to collaborate with the OSS community was emphasized: "*If we hit a major bug we would try and find some helpers ... but I don't think we will get it here in [South Africa]. We will have to go on to forums and communities*" (Developer).

Firm size – The organization is a large organization with over 2500 employees. The PBX platform serves 800 call centre seats. "*Because we are so large, we can throw a lot of resources at it, so it takes a lot of risk out of the equation.*" (MD of IT)

Technology skills – The lack of skills in the market place made the decision a challenging one: "*We just go look for VoIP engineers ... they are so difficult to find and that's the risk.*" (Head of Telephony Solutions) As a result, they mostly developed their own skills by providing hands-on experience and training: "*There was a training course that people went on ... again, very much a self-learning exercise*" (Head of Telephony Solutions). However, the key (Linux and VoIP) skills were available in the market: "*OSS would never have been an option if we weren't able to source skills externally and bring them in-house.*"

Environmental factors that did not play a role in this particular case study were political splintering, legitimacy and availability. Perhaps these factors are more important to adopting organizations of a smaller size.

5   Conclusion

The TOE framework takes cognisance of the internal and external context in which the company operates and comprehensively covers the adoption process. It served as a useful framework when looking at the full scope of OSS adoption. Although this research involved only a single system adoption in one large organization, almost all of the factors identified in the TOE framework were found to be of significance. Hopefully this research will give other organisations a comprehensive overview of factors to consider when contemplating OSS adoption.

6   Key References

Note: other references omitted due to space limitations

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