

USING THE BOOTSTRAP ALGORITHM FOR DEVELOPING AN INFORMATION SYSTEMS AUDIT PROGRAMME

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Abstract

As a side-effect of recent decades of successful information technology innovation, many organisations are developing complex networks of information systems that are becoming increasingly difficult to manage. There is a growing awareness of how this situation has to be approached through structured means with strong management commitment, but current frameworks for information technology governance, such as COBIT, CMMI and ISO 9001, involve so many factors and audit criteria that audit programmes become costly and difficult to implement. If one looks at the situation from an information infrastructure perspective, one might assume that the audit programme could be bootstrapped into place, but it is also known that this approach is likely to fail in communities that are locked into institutional patterns that reinforce design styles assuming vertical control and complete specifications. Still, the claim of this paper is that a bootstrap strategy is useful for developing ISO 9001-based IT auditing programmes if it is implemented in a prudent manner. This claim is investigated through action research in public administration, focusing on how to implement IT auditing by means of the so-called bootstrap algorithm (BA). What the research indicates is that the bootstrap approach is useful for getting the ISO 9001 auditing running in a way that gets quick results and makes it possible to gradually expand the focus in directions that add value to the process. The study adds evidence to the claim that the bootstrap strategy is an effective approach for responding to challenges in IT governance.

Keywords: Information infrastructures, IT governance, ISO 9001 auditing, action research.

1 INTRODUCTION

As a side-effect of recent decades of successful information technology (IT) innovation, many organisations are developing complex networks of information systems (IS) that are becoming increasingly difficult to manage. There is a growing awareness of how this situation has to be approached through stronger focus on IT governance (Weill & Ross, 2004), but current frameworks for governance, such as COBIT, CMMI and ISO 9001, involve so many factors and audit criteria that audit programmes become costly and difficult to implement (Gerke & Ridley, 2004). Trying to use complex IT governance structures for controlling complex IS networks may consequently make things even more complex and add to the problem rather than the solution. Are there better ways of approaching the situation?

By looking at the literature on how to develop ISO 9001 audit programmes, four main schools of thought can be identified. There are those who believe auditing programmes should be managed by vertical control and complete specifications (Tricker, 2005), there are those that recommend vertical control but incomplete specifications (Lillestøl, 1996), there are those who recommend distributed control and complete specifications (Grimes, 2000), and there are ways like the bootstrap approach from information infrastructure theory that embraces local control and incomplete specifications (Hanseth & Aanestad, 2001; Øgland, 2016). Given the nature of the problem, the bootstrap strategy is the approach that looks most suited for the situation, but it is also an approach that is assumed unlikely to succeed in communities

where institutional patterns lock the organisation into the other schools of design (Hanseth & Lyytinen, 2010).

Nevertheless, for investigating whether an IS auditing programme can be bootstrapped by use of the ISO 9001 standard in an organisation that believes in vertical control and complete specifications, it would be interesting to carry out action research to see the effect of the bootstrap strategy in practice.

The paper contributes knowledge to an important area of practice. Firstly, it gives a broad overview of different strategies organisations can use for developing IS audit systems based on ISO 9001. Secondly, it identifies and discusses the empirical results of applying the bootstrap strategy among these alternative strategies. This knowledge is valuable for managers with responsibility for IT governance and practitioners working on how to implement IT governance systems.

The paper consists of six parts. This first section contained a motivation and explanation of what is to be investigated. The next section is a selective literature review on ISO 9001 auditing and bootstrap theory, used for articulating an action hypothesis. The third section explains how the action hypothesis is to be tested empirically through action research. The fourth section presents the process and outcome of the test. Section five is a discussion of the validity and reliability of the findings. The final section links the outcome with the initial motivation and identifies opportunities for further research.

2 LITERATURE REVIEW

The purpose of the literature review is to articulate the idea of using the bootstrap algorithm (BA) as means for addressing the diagnosed problem of how to develop audit programmes. As the focus in this paper is on using the ISO 9001 standard for implementing IT governance, the first part of this section will be a short introduction to this standard. The next part will then describe the BA approach as one of four different groups of strategies that can be used for developing ISO 9001 audit programmes. Finally, the idea of using the BA for developing audit programmes will be formulated as an action hypothesis.

2.1 The ISO 9001 model

The history of ISO 9001 quality management systems standards goes back to the United States Department of Defence MIL-Q-9858 standard from 1959. By way of the NATO AQAP series of standards and the British Standards BS 5179 and 5750, the first ISO 9001 standard was published in 1987. Then followed ISO 9001:1994, ISO 9001:2000 and ISO 9001:2008, with ISO 9001:2015 subsequently being the the fifth edition of the standard.

Although the central ideas embedded in ISO 9001 have remained the same over the years, both the structure and the content of the standard have changed. Not at least has the influence of total quality management (TQM) from the automotive industry and other manufacturing industries had an impact on the standard, so today there is less discussion about differences between TQM, ISO 9001, Six Sigma, Lean Production and other quality management philosophies than there used to be. For instance, while Seddon (2000) made influential comments on how TQM, ISO 9001 and Lean were incommensurable, such comments have today been overshadowed by writings about how it may be necessary to integrate TQM, ISO 9001 and Lean for making effective quality management systems (e.g. Micklewright, 2010).

In the latest version of ISO 9001, the structure of the various clauses have been grouped to fit with the process model of quality management system shown in figure 1, using the so-called PDCA¹ method from TQM as a structuring device. This new model is slightly different from the previous version as the clauses have now been structured in a manner that is identical to comparable standards, such as ISO

¹ "Plan, do, check, act" (See: Deming, 1986)

14001 for environmental management systems, ISO 27001 for security management systems and OHAS 18001 for occupational health and safety management systems. Common for all these standards is that the first four chapters of the documents are of informative nature while the chapters 4-10 provide a common structure for the requirements that have to be addressed. Chapter 4 describes requirements concerning the whole system, as illustrated by the periphery in figure 1, and chapter 5 describes management issues seen at the core of the diagram. The five remaining chapters are grouped along a PDCA cycle.

There are also arrows leading into the quality management system and arrows leading out. At the left centre level we can see that customer requirements is the main input, although balanced by the organisation and its context from above and the needs and expectations of relevant parties from below. This aspect is new to the 2015 version and fits with a strengthened focus on how quality management is required to focus on external threats and opportunities and internal strengths and weaknesses (cf. SWOT analysis; Jackson et al, 2003).

The outcome of the process also consists of three channels. While the right-side top and the bottom channels focus on customer satisfaction and the quality of products and services, the central channel concerns the quality and improvement of the quality management system itself.

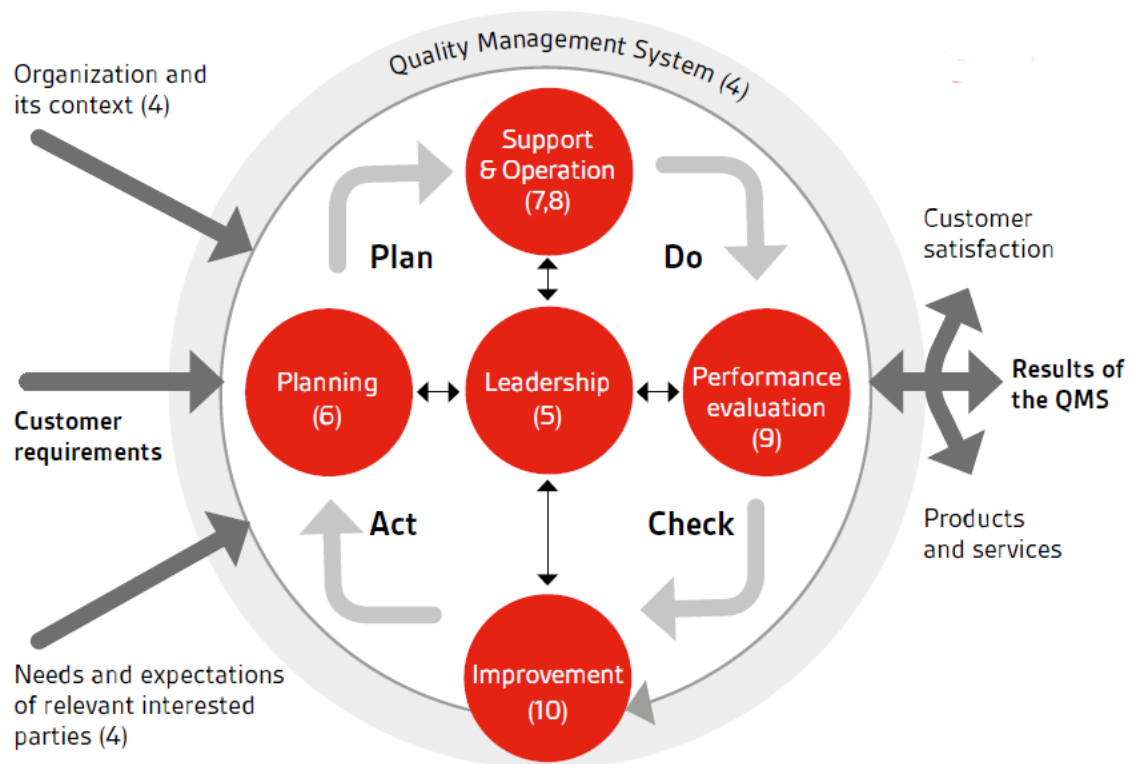


Figure 1. The generic ISO 9001:2015 process model²

Although the ISO 9001 standard is a set of quality management requirements for all types of industries and organisations, the standard can be thought of as a tool for IT governance when being applied within the IT industry or used for designing a quality management system for the IT function of a given organisation (e.g. Nanda, 2003). Having the quality management system of the IT function compliant

² <http://isoconsultantpune.com/iso-90012015-understanding-structure-terminology-concept/>

with the ISO 9001 standards also makes it easier to make IT governance fit with the requirements and expectations of the COBIT framework (Ribeiro & Gomes, 2009).

Given how the history of ISO 9001 started with military standards, it was for a period believed that the development of ISO 9001 quality management systems would increase the bureaucracy, strengthen vertical control, commodify workers and reduce the ability for improvement and flexibility (Seddon, 2000). However, as the standards have gone through several revisions and have been implemented in all sorts of diverse organisations, much of the debate has moved in the direction of how ISO 9001 quality management systems can be useful for making TQM and Lean efforts sustainable (Micklewright, 2010).

2.2 Using the bootstrap algorithm as audit strategy

There are no universal methods for developing ISO 9001 quality management systems, and there are no standard procedures on how quality management systems should be audited. Such issues may depend on the size and nature of the organisation, but there are schools of thought on how this should be approached.

In table 2 different thoughts on how to design ISO 9001 audit programmes are presented by considering (a) the dimensions of how the programme is sequenced according to the chapter structure of the standard and (b) to which extent it is recommended that each clause should be fully audited before moving on. All the approaches can be carried out in compliance with the ISO 19011 guidelines on how to do management system audits, but they represent different auditing philosophies.

	<i>Complete audits</i>	<i>Incomplete audits</i>
<i>Sequential audits</i>	The ISO standard is the object of investigation and the trail of the standard defines the audit programme (Seddon, 2000; Tricker, 2005).	Use risk analysis and statistical sampling for making annual audit plans (Lillestøl, 1996).
<i>Non-sequential audits</i>	Define how frequently different clauses/processes should be audited for covering the complete system within a given period (Grimes, 2000).	Follow the trail of the process (Seear, 2012; Øgland, 2016).

Table 2. A classification of how to audit ISO 9001 quality management systems

The upper left corner of the table represents a classical approach of starting with the first clause of ISO 9001, making sure this is audited properly, and then move on to the next, until all clauses have been covered. By following this approach, the auditor is guided through the PDCA circle from figure 1 in a logical manner that starts with understanding the context, and then continues by looking at management commitment, planning, production, results and improvements. Tricker (2005) provides tools and guidelines on how this can be done.

However, when Seddon (2000) argued his case against ISO 9000 by saying that it was incommensurable with TQM and Lean, it was this approach, of focusing on making the organisation comply with the standard rather than using the standard as a tool for improving organisational performance, that was at the core of his argument. This is an argument that became popular at the time, and was expanded and more deeply explained by Brunsson and Jacobson (2000) in their observations of how the whole ISO 9000 industry contributed to a world based on a dualism between what the standards were designed to achieve and what happened when they were being implemented. As they argue, these two worlds can sometimes be seen as completely disconnected.

Apart from the sociological explanations of why the straight-forward approach in the upper left corner may not be successful, the futility of this approach may in some cases also be explained by considering large organisations where it would take an insurmountable amount of time and effort for checking each of the ISO 9001 clauses. The design philosophies in the lower left and upper right of the table illustrate practical ways of dealing with this. For instance, Grimes (2000) argues that the problem of being unable to cover all the requirements of the ISO standard within a year can be overcome by enlarging the audit team, or, as Hoyle (2006) points out, perhaps it is necessary to allow more years for each complete audit of the system. An alternative approach, suggested in the upper right quadrant, is to follow the sequential order of requirements defined by the standard, but to reduce the size of each audit by looking at parts of the quality management system, applying methods of statistical sampling or risk-based management.

The approach in the bottom right quadrant is the exact opposite of the classical approach from the top left. In this case the idea is to audit opportunistically by following any sequence that seems relevant and audit at any depth considered necessary for producing results that are of value for the organisation, and then gradually expand on audit practices until a complete quality audit system has been completed. The original bootstrap algorithm (BA) was developed by Hanseth and Aanestad (2001), but has later on been adapted into a strategy for developing IT audit programmes by aligning with Seear's (2012) views on ISO 9001 auditing, to produce the design method for audit programmes shown in table 3.

Start with:

- simple, cheap, flexible audit system
- small network of auditors that may benefit significantly from improved communication with each other only
- simple audit practices
- non-critical audit practices
- motivated auditors
- knowledgeable auditors

1. Repeat as long as possible: Enrol more auditors from units inside and outside of the organisation
2. Find and implement more innovative use of audit systems; go to 1
3. Use audit systems in more critical cases; go to 1
4. Use audit systems in more complex cases; go to 1
5. Improve the audit system so new tasks can be supported; go to 1

Table 3. A bootstrap algorithm for developing IT audit programmes (Øgland, 2016, p. 239)

The purpose of the bootstrap strategy is to develop a complex network of systems, users and practices, by means of starting as simple as possible, and then expand along the dimensions described through the first four steps of the algorithm until a complete network has been established. The approach was originally inspired by how computers are bootstrapped ("booted") by having software recursively loaded into memory each time they are turned on, but bootstrap theory can also be viewed more generally as a theory that is applied in computing, statistics, business, biology, law, linguistics, physics and so on³.

Although the BA is articulated in pseudo-code, Øgland (2013) argues that it has much in common with the genetic algorithm (GA), which has led some researchers to see both the GA and the BA as belonging to the same group of pseudo-code search algorithms known as metaheuristics (e.g. Salmani & Eshgi,

³ <https://en.wikipedia.org/wiki/Bootstrapping>

2017). However, no studies have been found where the BA has actually been programmed into a computer. Mostly the BA is used as a theoretical device to discuss the difference between bootstrapping in theory and practice (Hanseth & Lyytinen, 2004; Manda & Sanner, 2012; Øgland, 2013).

As explained by Skorve & Aanestad (2009), the main driver of the BA is the statement about including more users at the beginning of the control loop, but when they want to use the algorithm for dealing with challenges where novel and undefined technology meets a complex organisation, they stress the importance of knowing where and how to start. In table 3 we are instructed by the algorithm to "start with...", blackboxing the challenge in finding the right starting point, and making sure that each iteration of the control loop leads to sustainable improvements. When having redesigned the BA for the specific purpose of developing audit programmes, there is also a question of how large is the population of auditors that might eventually realise that they can benefit from shared communication.

Although the focus on auditors, audit practices and audit systems gives a clearer focus than the original reference to users, practices and systems, the aim of the process is nevertheless to bootstrap IT governance, which includes managers and people engaged with standardisation and control without necessarily being auditors or seeing their systems and practices as audit systems and audit practices. However, if one keeps this particular point in mind, the general idea is nevertheless to make connections between those who conduct quality audits according to clause 9.2 in ISO 9001:2015 with others within the organisation who are engaged with internal audits, and connect these people with internal and external units conducting second-party audits (supplier audits) and third-party audits (e.g. certification audits).

As shown by Brunsson and Jacobson (2000), such people make up a vast network, and if we include others that are part of the ISO 9000 industry or related industries, there should be many opportunities for building internal and external networks in the process of trying to bootstrap ISO 9001-based IT governance for a given organisation.

2.3 The bootstrap hypothesis

The action hypothesis of this paper is that it is possible to develop a successful IT audit programme by means of starting simplistically and then expand and improve the programme by means of exploiting opportunities as they arrive, following the logic of the BA in table 3.

3 METHODOLOGY

As the purpose of the research is to evaluate the bootstrap hypothesis through a field experiment, the five-step method of diagnosis, action planning, intervention, evaluation and reflection from canonical action research (CAR) (Davison et al, 2004) is a natural approach. While the diagnosis and theoretical part of the planning has been described in previous sections, and action, evaluation and reflection will follow in the next three sections, this section will focus on the action planning by means of describing the organisational context, the intervention design and the collection of data and analysis.

3.1 Organisational context

The organisational context of the action research is a part of the Norwegian public administration that employs about 6500 people and has an IT function of about 880 people. The IT budget is about 20% of the total budget, and the information infrastructure has been growing organically for several decades. In order to implement and improve IT governance, a quality management structure for the IT function was made operational in 2000, with an initial map between the quality management system and the ISO 9001 standard being created in 2005, while a process of improving the quality management systems towards becoming ISO-certifiable started in 2008. The main task for those representing the strategic level of the IT function is to develop the long-term IT strategy and to monitor how it is being implemented by means

of the quality management system. The viewpoint of the action research study is aligned with this strategic perspective of wanting to implement IT strategy at the operational level.

3.2 Intervention design

Although the action research builds on several decades of action research on related issues within the same organisation (Øgland, 2013; 2016), the formal start of this particular research project was in January 2017 when the action researcher met with the client organisation for aiding the CIO (head of the general-director's IT staff) on how to make sure the IT strategy was being implemented through the use of the Lean ISO 9001 framework (Øgland, 2017). After establishing a researcher-client agreement (RCA), the practical work started in April 2017 with the researcher getting an office in the client organisation and developing plans for bootstrapping an audit programme for verifying the claims of compliance and performance of the Lean ISO 9001-based quality management system for the IT function.

The practical implementation of the bootstrap algorithm started in May 2017, with the action researcher contacting the owner of the quality management system and explaining how he was aiming to verify it on behalf of the CIO. The first aim was to discuss how to start auditing in a manner that would comply with the initial statement in the algorithm in table 3, and if this could be achieved the next aim would be to bootstrap the IT governance system by means of following the logic of the control loop.

If this second aim could be achieved, the intervention would then continue indefinitely until the algorithm would break down or the complete IT governance infrastructure would be in place. However, for the purpose of gaining insights from the experience, it was seen useful to observe the effect of the bootstrap algorithms during shorter intervals. This paper is consequently the first of perhaps several papers describing different stages of this particular bootstrap process.

3.3 Data collection and analysis

As the bootstrap algorithm is formulated by means of pseudo-code rather than being formulated on the level of precision that is needed for executing the algorithm on a machine, it is not falsifiable in the traditional sense. However, actions emerging from the algorithm are falsifiable in the sense that either will the audit programme sustain and grow or it will crash. The evaluation of the action hypothesis will consequently focus on the outcome of how the algorithm is interpreted and executed in a particular context. Data will primarily be collected by observation and analysed by means of reflection.

4 RESULTS

As the BA consists of an initial step and a control loop, the results of execution will be reported accordingly with some additional reflections to comment on the execution of the BA as a whole in relation to the prediction embedded in the BA hypothesis.

4.1 The initial step of the BA

After the researcher became an operative part of the client organisation in April 2017, there were six communities within the client organisation that would be interesting to connect for the purpose of bootstrapping the IS audit programme. The communities were (1) the community of the IT staff, which was the viewpoint for doing action research, (2) the quality management community, (3) the internal audit community, (4) the lean management community, (5) the information security management community, and (6) the community associated with the research liaison of the organisation.

The initial step of the BA consisted of trying to link the three first of these communities. This was done by first presenting the idea to IT staff about how the IT strategies were expected to be implemented through the quality management system of the IT function, thus trying to get acceptance for intervening in

the quality community by means of referring to the IT strategy and the authority of the CIO. This part of the process covered about four weeks, and consisted of informal discussions and formal presentations at two of the weekly IT staff meetings.

Having reached an RCA in terms of reaching a common understanding on what was to be accomplished, the next step was to make contact with the quality community and explain and discuss how the process could be put into action. This part of the process started in May 2017 and consisted of a formal presentation, a formal meeting and then a mutual agreement of going through the ISO 9001:2015 requirements by starting with clause 9.2 ("internal quality audit").

The reason for starting with this clause was twofold. Firstly, the quality audit process was an ideal starting point from the viewpoint of the BA because it would make it possible to design actions in the shape of second-party audits by aligning with processes, principles and templates that were already in use. The installed base in the initial part of the BA would consequently consist of the audit community within the quality management community, bridging together two small communities in a way that would improve communication. By focusing on the theory of "lean auditing" (Paterson, 2014), the practices were simple, non-critical and the people on both sides were motivated and knowledgeable.

The second reason for starting with clause 9.2 was because of how this clause had resulted in nonconformity when the internal audit community had done an audit of the quality management system a few years earlier. This meant that it was both a formal reason for checking this particular clause, and it was also a way of establishing contact with the internal audit community. However, there was no obvious way of expanding the installed base by also bridging with the internal audit community as there was nothing for this community to gain from such discussions and collaboration. On the contrary, for the internal audit it was important to remain objective and impartial by not participating in any types of collaborations.

4.2 The control loop of the BA

By agreeing to do annual follow-ups of the quality audit process within the quality management community, the type of system described in the initial step of the BA had been created. This meant that it was time for trying to expand the IS audit programme by considering other ISO clauses and parts of the quality management system that should be addressed next. One possibility, for instance could be to engage with the internal auditors within the information security management community, but when suggesting this to the internal auditors of the quality management community, there was no overwhelming response. On the contrary, what the representative of quality auditing suggested was to look at the health check process within the quality community, as this was similar to the quality audit, although simpler and involved more people. The process would relate to clause 9.1 in the ISO standard.

Following the logic of the BA, such opportunities were being made note of, but there were also other alternatives, like considering clause 9.3 "management review" as this was a potentially simple process which could have big impact on the success of implementing ISO 9001. Clause 10.3 about noncompliance and corrective action was another interesting possibility as that could be used for investigating the corrective actions carried out after the first audit had been completed, which would then fit with Seear's (2012) suggestion to do ISO 9001 audits by following the audit trail.

Furthermore, as the quality management community said they were interested in getting feedback from IT staff about quality challenges and opportunities for improvement, this resulted in a discussion at the next IT staff meeting where it was said that planning (ISO clause 6) was interesting. Other issues of relevance were the various identifications of lack of compliance with ISO 9001 that had been identified in the quality audits but not used for designing corrective actions. In other words, the initial round had paved way for several ways to expand the IS quality audit programme, but the question was where to go first.

The challenge was addressed by designing two meetings before the summer holidays. The first meeting was with the quality auditor for discussing planning, health checks and root cause analysis, planning to use this interview as data collection for a series of audits to be started during summer and completed in the autumn. The other meeting was with the process manager for "management review", which would then be the next main focus for expanding the IS audit programme.

The interview with the process manager went well. Most of the audit report had been written in advance, and the meeting resulted in a positive and lively debate which indicated that there would be mutual benefit from continuing the collaboration. Consequently, a follow-up for "management review" was planned for the next year, and the process manager recommended looking at leadership (clause 5 in ISO 9001) as the next audit theme.

4.3 Evaluation of the BA hypothesis

By defining week 16 of 2017 as the time of starting the BA, by the time of week 33 the algorithm had been running for 18 weeks without breaking down. This is too short for a conclusive evaluation of the BA, but so far the algorithm has been highly successful. Rather than planning too much in advance, or following traditional methods of starting with interviewing management to make sure there is commitment and then looking at individual processes in a top-down manner, the use of the BA for going with the flow and seizing opportunities for cultivating practices and increasing the installed base has contributed to the first steps of an IS audit programme that develops in an organic manner.

Although there have been critical questions raised by all the communities involved, such as IT staff wanting more focus on the type of processes that are more critical, the quality community being hesitant in being reviewed against ISO 9001:2015 as they were still trying to comply with ISO 9001:2008, and the internal audit perhaps feeling a bit unsure of whether this second-party audit practice is interfering in their domains, but the absence of breakdowns despite these minor obstacles gives a temporary confirmation of the theoretical predictions inherent in the BA strategy. In other words, the data collected and analysed support the BA hypothesis.

5 DISCUSSION

The outcome of the intervention was in correspondence with the expectations of the BA hypothesis, but it is necessary to reflect on the reason for this correspondence. Could there be factors not related to the BA causing it to be confirmed, or was there something about the case that made the experiment confirm to the hypothesis although this would have been less likely to happen under different circumstances?

5.1 Validity

When considering the validity of the claim that the BA has been running successfully, the question is whether the success is a side-effect of how the experiment has been designed rather than a consequence of the algorithm itself. For instance, at the early stage of having the BA put into motion, the organisation may be more hesitant to complain than it may be at a later stage, as the people do not yet fully understand the nature of the BA. There may consequently be a period of politeness before a conflict materialises. Also, the fact that much of the time accounted for in this study is part of the summer holidays means that much of the study was carried out at a time when there were few people present to resist the strategy.

On the other hand, one might expect this kind of response for all of the four types of implementation strategies discussed in the literature review. In fact, delayed conflict would be more naturally to expect when auditing ISO clauses in the order of how they are presented in the standard as this would mean starting with unpolitical issues like how the quality management system is designed (clause 4) and whether there is management commitment (clause 5). As a management system can be designed in many ways, it is unlikely that there should be severe gaps when looking at this, or if gaps should be identified

one might expect that it would be relatively easy to have the organisation acknowledge the gaps and have them filled. In the case of management commitment, this is often considered the central point of succeeding with ISO 9001 or any quality management approach (e.g. Beckford, 2003), but it is still unlikely that one should find severe problems when entering ISO clause 5 as most organisations claim to have management commitment to their systems. It is only when observing what is happening in practice it is often observed that there are differences between the talk and the walk (Brunsson & Jacobsson, 2000).

In other words, what makes the BA approach different from the other approaches, which either commit to doing complete audits or sequentially follow the chapter structure of ISO 9001 as basis for the audit programme, is that the logic of the BA is to engage with the operational quality management activities right away. The BA approach maximises the interaction with the auditee community from day one. Rather than trying to delay conflicts by trying to understand the quality management system before auditing it, what was done in the reported case was to look at processes like quality auditing and management reviews, that did not require all that much contextual knowledge, and then engage in discussions about how such processes are currently performing and how they could be improved. In this sense, the BA sets up for potential conflict right away, so when the process has still managed to survive for a period of 18 weeks without breaking down, this should be seen as a very good sign indeed.

It is also important to acknowledge the point made by Hanseth and Lyytinen (2010, p. 16) about how the logic of the BA works against the logic of the bureaucracy. In their estimation, it is expected to be difficult to implement the BA in the type of environments where it is most needed. However, what we see in this study is an example of a highly bureaucratic organisation, which is reluctant to engage in any kind of initiatives unless they have presented in manner that fits with the logic of the bureaucracy (Øgland, 2016), but where the BA appears to be successful if applied in a prudent manner.

The fact that there have been several unsuccessful attempts to get the BA started in a more formal manner (Øgland, 2013; 2016), indicates that the preliminary success of the BA by simply starting it goes against the logic and nature of the organisation. If one were to use any of the other implementation strategies discussed in the literature review, there would be much higher risk for developing a solution where the organisation "pretends" to be following ISO 9001 while actually not doing so (Brunsson & Jacobsson, 2000; Øgland, 2013). An explanation for why the BA seems to be working has to do with the nature of the BA itself because there is nothing in the environment that would make it work. On the contrary, most everything in the environment would predict that the only way of implementing a supplier audit system would be by following a top-down approach that would involve a large number of employees, multiple layers of management and extensive paper work.

5.2 Reliability

If we accept that the BA actually seems to be working successfully in this particular case, how reliable are the results? Is there reason to believe that the BA would work with similar success in a slightly different environment, or is the reason for success to be found within the particular group of people that was part of these 18 weeks of experiment? Although individuals and environments may play a role in the success of the BA, the point that should be made here is that the logic of the BA is to search for environments where the bootstrapping is likely to succeed, and then try to build on this approach. In this particular case, the installed base was the auditor community and its relation to clause 9.2 in ISO 9001:2015. The reason for focusing on the auditor community rather than something else was because of how this fitted with the logic of the initial statement of the BA.

In an earlier study of trying to achieve the same thing in the same organisation, it looked like the COBOL standards and the COBOL software development community was a good place to start (Øgland, 2006; 2013). In that particular case, the COBOL software monitoring system was easy to implement, it gave benefits to a small group of people, and it was possible to expand into larger auditing tasks, although it

was later seen not to be sufficiently robust and thus finally collapsed. While it looked like the systems, clients and practices associated with the quality auditing of the COBOL software fitted with the initial statement of the BA, this was true for a period but then turned out to be wrong.

Part of the problem with the COBOL case was that the control software was being run by the COBOL developers themselves, driven by their own interests in improving the software, but once they lost interest in running the control software and reporting the results, the system was unable to survive. In the case of the ISO 9001 auditing system, the process does not depend on this kind of weak link. As long as the action researcher has access to the quality management system, he can continue collecting data available to him, and make his ISO 9001 judgements based on this, regardless of whether he has access to all the relevant data or not.

As was also observed in the case of discussing validity, the logic of the BA is to avoid sweeping problems under the carpet. On the contrary, what the logic of the BA prescribes is to look for aspects of the quality auditing that works and then try to expand upon this in various directions. Unlike the three other strategies for developing IS auditing programmes, the BA is designed to aid the developing of the audit programme in finding solutions, people and practices that can be bridged together and improved, thus focusing more on operational aspects of quality control, such as the efficiency of preventive and corrective action, and thus paying less attention to traditionally important issues such as management commitment and the structure of the quality management system.

While there is no guarantee that each and every aspect of the ISO 9001:2015 standard can be covered by following this approach, the only reason to doubt the reliability of the results from this study is to identify similar types of studies conducted in similar environments that have failed. As has been observed in earlier studies (e.g. Øglund, 2008), an important ingredient for making the BA succeed is to have at least one person using it as a design strategy. If this person is removed from the system, the BA stops operating, and there will be no results. This was also a point that was addressed in section 4.2 when the issue of paying attention to the owner of the audit system was discussed, but for the action research covered in this paper it has not been a problem.

6 CONCLUSION

This study started with the observation of how complex IT governance frameworks could add to the complexity of trying to manage the information infrastructure, thus adding to the problem of the situation rather than the solution. Looking at different ways of implementing IT governance by means of IS auditing programmes, the strategy of bootstrapping the IS auditing programme was considered, although it was also acknowledged that the bootstrap strategy is only likely to work in organisational settings where the logic of the approach is not contradicted by institutional forces.

By conducting 18 weeks of action research in a public sector organisation that operates on principles contradictory to those needed for running the bootstrap algorithm, it was nevertheless shown that an IT governance infrastructure is starting to build. So far the IS audit programme has been developing according to the logic of the bootstrap algorithm by focusing on continuous improvement, local innovation, acceptance of chaos, simple designs and crude abstractions, making the IT governance practice emerge by aligning with people, systems and practices related to the quality management practice within the IT function of the organisation.

The results indicate that the earlier research about bootstrapping information infrastructure may have been too modest about the strength of the bootstrap approach. Although it seems reasonable to expect that institutional forces working against the nature of the strategy may create difficulties in making it work, what is indicated by this study is that it may still be possible to develop the relevant IT governance infrastructure by going about in a prudent manner, following the logic of the bootstrap algorithm while also being careful when talking about the approach. It may be more important to emphasise how the

bootstrap algorithm aligns with the logic of TQM rather than how it might conflict with institutional perspectives on IS development.

As this study reports from the first few months of implementing IT governance, a natural follow-up on the study would be to observe how the IT governance continues to develop over time. Not only would it be interesting to report from the continual bootstrapping in this particular case, but it would also be interesting to see similar action research from elsewhere. Although there is much literature arguing the strength of the bootstrap strategy (e.g. Hanseth & Aanestad, 2001; Hanseth & Lyytinen, 2004; Hanseth & Lyytinen, 2010), there are hardly any studies aimed at testing the strategy in practice.

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