How to Plot Current Pilots on the Audit Maturity Model?

The Continuum Paradigm

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***Abstract*—Continuous monitoring, continuous control monitoring, continuous auditing, continuous assurance and continuous reporting and the Continuum Paradigm are topics in which research has been performed for more than 30 years. The possibilities and challenges of these elements have been researched. However, limited studies focused on the holistic view and the status of an pilots, financial as well as non-financial data, in relationship with the Audit Maturity Model have been performed. Based on the existing studies, we defined the following research question: What is the actual status regarding the Continuum Paradigm? Based on a review of pilots and plotting the results of the pilots on the Audit Maturity Model by a focus group, further insight is provided regarding the actual status. The overall conclusion is that the average maturity level for Continuous Monitoring and Continuous Assurance reaches nearly stage 3: Maturing and no research has been performed based on a holistic and fully integrated continuous process.**

Keywords-Audit Maturity Model; Continuous Monitoring; Continuous Auditing; Continuous Assurance; Continuous Control Monitoring; Continuous Reporting; Continuum Paradigm; Financial and Non-financial Data; Sustainability Reporting.

I. INTRODUCTION

Scientific papers in the context of the Continuum Paradigm have often been descriptive in nature in recent years. Common concepts within this research area are Continuous Monitoring (CM), Continuous Control Monitoring (CCM) Continuous Auditing (CA), Continuous Assurance (CAss) and Continuous Reporting (CRe). This whole is now referred to as the Continuum Paradigm [1]. The definition of the Continuum Paradigm is a holistic and pragmatical CA maturity model, which facilitates the assessment of CA capabilities [1].

Only a few studies have been conducted in practice within Continuum Paradigm, combined with results of pilots. What is the actual status regarding the Continuum Paradigm? Based on earlier research the aim is to provide insight in the actual status.

Maturity models [1] [2] can be helpful to provide insight in the actual status. Maturity models enable organizations to assess their current situation and provide handholds for improving and future research. An example of the maturity model is the Audit Maturity Model (AMM) proposed by, Vasarhelyi, Alles, Kuenkaikaew and Littley [2]. For the purpose of our research, we assessed and plotted the outcomes of a number of selected pilots on a maturity model.

The remainder of this paper is structured as follows. Section two summarizes the results of the literature review. The research method is described in section three. Section four, the data collection is described. The results are described in section five. Section six describes areas for future research. Finally, the paper concludes in section seven with the conclusion.

II. LITERATURE REVIEW

The need for ongoing, timely assurance of data and information utilizing CM, CCM, CA, CAss and CRe is becoming more and more apparent.

In the last decades, Vasarhelyi, Kuenkaikaew, Alles and Kattie Willems [3] performed research in the area of CCM, CM, CA, CAss. However, this research was mainly related to financial data. Nowadays management needs more and more data to provide assurance of non-financial data, driven by regulation e.g., regarding climate change and the appetite of stakeholders to be timely informed.

Due to these developments the interests for CM, CA, CAss and CRe grow. When assessing the reliability of data produced by the system, the auditor will review confidentiality, integrity, and availability and how the data is ensured by the system of internal controls. IT technology and the AMM can be used to allocate the current status of CM, CCM, CA, CAss and CRe. The allocation provides insight in the actual level of auditing. This is relevant information to guide research and further developments of these elements.

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There are several ideas of what continuous concepts and systems are, and how they work. Each of the concepts has their own definition. CM is "the process and technology used to detect compliance and risk issues associated with an organization's financial and operational environment" [4]. The financial and operational environment consists of people, processes, and systems, working together to support efficient and effective operations. Controls are put in place to address risks within these components. Through CM of the operations and controls, weak or poorly designed or implemented controls can be corrected or replaced – thus enhancing the organization's operational risk profile. Investors, governments, the public and other stakeholders continue to increase their demands for more effective corporate governance and business transparency.

The most widely accepted definition for CA is the one released in 1999 by CICA/AICPA and reads as follows: "a methodology for issuing audit reports simultaneously with, or a short period of time after, the occurrence of the relevant events" [5]. The definition for CAss released by Vasarhelyi is therefore "an aggregate of objectively provided assurance services, derived from continuous online management information structures—the objective of which is to improve the accuracy of corporate information processes. These same services may also provide different forms of attestation including point-in-time, evergreen, and continuous" [6]. CAss and CRe are closely linked. There is no CAss without monitoring and intense measuring of the data and data sources.

The AMM classifies the audit evolution into four stages, which are traditional audit, emerging, maturing, and continuous audit. Per stage seven domains have been considered: objective, approach, IT / data access, audit automation, audit and management sharing, management of audit functions, and analytical methods [7].

The first domain is related to a "level of internal audit organization providing financial reports and monitoring internal controls". The second domain approach is related to a "method of audit review, frequency and technique". The third "domain IT / data access" is related to level and frequency of access to the information system and data. The fourth domain "audit automation" is related to the automated level of auditing, usage of technology to assist the audit review cycle. The fifth domain "audit and management" sharing is related to an internal audit department shares systems and resources with management. They have access and utilize the system together. The sixth domain "management and audit function" is related to the degree of cooperation between financial audit and IT audit, collaboration with other compliance departments. The seventh domain "analytic methods" is related to the level of analytical procedure that an internal auditor performs, techniques, and details. The general purpose of maturity model is to provide guidance for a sustainable implementation and growth for organizations [8]. See Table IV: Audit Maturity Model.

To improve the readiness of the article, all relevant abbreviations are presented in Table I below.

TABLE I. OVERVIEW RELEVANT ABBREVIATIONS OF THE ARTICLE

Abbreviation	*Description*
AMM	Audit Maturity Model
CA	Continuous Auditing
CAss	Continuous Assurance
CM	Continuous Monitoring
CMM	Continuous Control Monitoring
CRe	Continuous Reporting

III. RESRESEARCH METHOD

The goal of this study is to create an overview of the actual status of the separate elements of the Continuum Paradigm. Maturity models are a well-known instrument to support the improvement of functional domains.

A focus group is a group interview involving a small number of participants who have other common experiences. The focus group should be based on the group of individuals that best represents the phenomenon studied. A focus group existing of 1) a junior researcher, with broad experience in internal and external auditing, 2) a senior researcher (PhD) with broad experience as external auditor and 3) a senior researcher with broad experience on business rules management has been established. Before a focus group is conducted, a number of topics need to be addressed: 1) the purpose of the exercise, 2) the selection of the participants, 3) the number of participants, 4) the protocol of the focus group, 5) the AMM model, 6) the protocol for plotting the pilots on the AMM model and 7) useful pilots for research.

Based on the research performed in the past there are different AMM models available. First, we needed to select which AMM model could be used as reference model for this study. The AMM as described by Mantelaers & Zoet [1] and the AMM as described by Vasarhelyi [2] have been selected as starting point. Both AMM's have been compared. The AMM of Vasarhelyi has been used intensively in research articles since 1990. This AMM has also been used as reference for one other similar study (Metcash's). For that reason, it has been decided to use the AMM of Vasarhelyi.

The next step was to define what pilots could be used to perform this study. Research articles during the period 1990 until 2011 have been selected using the following separate and combinations of the key words: audit, auditing, assurance, combined, control, continuous, data, external, financial, integrated, internal, maturity, model, monitoring, non-financial, pilot(s) and studies. The results have been reviewed by the focus group resulting in seven useful articles. Based on the review of the articles there are limited articles published containing sufficient detailed data and information to make it possible to rank and plot the results in the AMM of Vasarhelyi. The content of the selected articles, the level of detail of the data, level of detail of description of the data collection have been investigated. Based on the defined seven sections of the AMM and the data in the articles we searched for relationships and references. In case identifying that there were sufficient relationships and reference these articles were selected to rank and plot the results in the AMM.

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In the article of Hardy and Laslett, the results of the study have been plotted in the AMM [8]. The aim of this paper is to report on the implementation of CA and CM at Metcash Limited, an Australian wholesale distribution and marketing company (hereafter, Metcash). The results for this organization are so far notable: over 100 fully automated tests performed daily, a fully integrated exception management system, advancement from data to predictive analytics, and the use of visualization technologies for enhanced reporting. The results of this study have been used as reference to compare the results.

Every participant followed the same protocol, each starting with an introduction and explanation of the purpose and procedure of the meeting. After the introduction, ideas were generated, shared, discussed, and refined by the participants. Furthermore, the participants were invited to submit secondary data regarding CM, CA, CAss and CRe in the AMM.

Based on the pre-work, two pilots have been identified by the participants useful for plotting the results on the AMM. Each participant plotted the pilots individually. The results have been collected and the average results have been calculated for all three pilots. The average results of the two pilots have been compared with the reference pilot of Metcash's. The results have been shared and discussed with the Focus Group. During this meeting conclusions have been defined and agreed.

IV. DATA COLLECTON

Per pilot further information will be provided as well as the reason why the data has not been used for further research.

A. Reference Pilot: Metcash's

The goal of the Metcash pilot (the subject) was to provide key lessons relating to the adoption and implementation of CA and CM because of its advanced maturity. A maturity assessment of Metcash's CA/CM activities was conducted [2]. The results are mapped onto the four stages and seven dimensions.

This research has been performed during 2015 and the articles provided detailed information how to plot the results of a pilot or study [8]. For that reason, the outcome of this study has been used as reference to provide insight in the gap and deviations with other pilots or studies.

Reference research three Pilots: SAPSECURE, CAMAP and BAGHEERA-S™

The goal of this study of the three studies (1) SAPSECURE. (2) CAMAP and (2) Bagheera-S™ is to collect evidence from actual implementations for the need of CA and CM [9]. SAPSECURE was developed to permit auditors to review SAP security settings on a regular basis. It may also be used to provide answers to questions such as, ''Who can create a vendor, enter an invoice, and pay it?'' SAPSECURE was implemented and tested in a large public-sector organization. The design of CAMAP is based on surveillance of financial transaction data with the intention of profiling and identifying users that violate Segregation of Duties. This CA/CM solution provides an automated, independent mechanism for monitoring key business processes within an organization. Bagheeera-S™ has the capability to report on three key business processes: (1) Payroll / Human Resources, (2) Procurement and (3) Finance. The results of the three studies SAPSECURE, CAMAP and BAHEERA-S™ could not be used to plot the results on the AMM as data was missing with regard to approach, IT/Data Access, audit and management sharing and management of the audit function.

B. Pilot: VODAFONE

The AICAP published a booklet Audit Analytics and Continuous Audit. In this booklet reference is made to the Vodafone Iceland pilot: Implementing Continuous Monitoring [5]. The scope of the project was to implement exMon for revenue assurance as revenue leakage is a known issue in the telecom industry, to decrease the time required to process the financial closing month-end, fraud detection and to enhance the quality of the Customer Relationship Management. The data of the Vodafone Iceland project was limited and for that reason this could not be used to prepare a AMM rating.

C. Pilot: Siemens

Working with Siemens presented an excellent opportunity to test how CA would move from concept to implementation. Vasarhelyi predicted both that ERP-enabled firms are the environments most suited to first deploy CA, and that the course of the implementation would begin with automation of existing audit procedures and then, once the feasibility and value added has been demonstrated, move on to re-engineering the audit to make it more CA ready [3].

At Siemens several hundred procedures regarding Audit Action Sheets are be made up of which describe in considerable detail what the internal auditor is supposed to test for in each SAP system environment. After examination of 25-30 Audit Action Sheets, twelve were chosen as representative of the challenges on automating and reengineering. The Audit Action Sheets are related to inadequate protection for SAP access. Testing one of the major general IT controls, logical access, which is non-financial data. In Visual Basic a prototype has been developed. The Siemens experience indicates that in environments characterized by highly automated business processes, CA can be defined as a process that continually tests controls based upon criteria prescribed by the internal auditor and identifies exceptions for the internal auditor to perform additional procedures. During this project the CM of internal control settings into the CA concepted model have been achieved. This included the treatment of transactional level data (non-financial).

D. Pilot: HSP

The HSP project is based on modeling processes required data at a highly disaggregate level, far below the level of account balances that are used in the standard audit analytical procedures. Due to fact that there was access to the full richness of the dataset, it was feasible to create the process-based audit models using as benchmarks. Continuity

Equations (CE), which has been defined by Rogers as stable probabilistic models of highly disaggregated business processes [10]. The CE defined is related to the following strictly enforced business rule of the procurement process: no deliveries are to be accepted without a cross reference to a purchase order. The existence of a deterministic relationship between the counts of purchase orders sent and of the shipments received can be tested. The HSP experience indicates that for CE systems of this level of complexity requires powerful statistical techniques which allow for dynamic set of CEs with multiple time lags and feedback loops. The experience also made clear that CEs to become an essential component in the future CA systems, they will have to be sufficiently easy to implement. This which means that generic CE models developed in the laboratory must be generally applicable to different firms and processes.

E. Plotting Pilots Results on AMM

The focus group used the data of the Siemens Project and HSP project to complete the AMM as the provided data was sufficient to make plotting possible. The outcome is presented in the Table II, which contains an overview of the results per pilot, the reference pilot and average for the seven sections of the AMM.

TABLE II. RESULTS PILOTS AND AVERAGE AMM

	Pilot 1: Siemens	Pilot 2: HSP	Pilot 3: Metcash	Average results
Objectives	2.3	2.5	3.0	2.6
Approach	2.7	1.3	3.0	2.3
IT/Data access	3.0	2.7	3.0	2.9
Audit automation	2.5	2.7	3.0	2.7
Audit and management sharing	2.3	2.3	3.0	2.6
Management of the audit function	2.0	2.0	2.5	2.2
Analytical methods	2.3	2.7	3.0	2.7
Total	19.3	16.0	20.5	18.6
Number of sections	7.0	7.0	7.0	7.0
Average	2.8	2.3	2.9	2.7

Table III provides insight in the elements that have been in scope of the pilot. The first column of Table III refers to the main scope of the pilot, Assurance, Audit or Monitoring. The second column of Table III relates to the part of the Continuum Paradigm in scope of the pilot e.g. CRe, CAss, CA, CM and in addition related elements such as process data, general IT controls, Internal Control System and Enterprise Risk Management system. The elements process data, general IT controls, Internal Control System and Enterprise Risk Management system are added as these are relevant for the external audit to decide the final level of assurance of the audit. The elements process data and general IT controls are defined further in detail. In case 'In scope' is mentioned the related element was part of the pilot. All the other elements were not part of the pilot and for that reason no research has been performed to the Continuum Paradigm based on a holistic view.

TABLE III. SCOPING PILOTS ELEMENTS CONTINUOUS

Scope	Part	IT or Data	Results of the Pilots	
			Pilot 1 Siemens	Pilot 2 HSP
Assurance	Continuous Reporting			
	Continuous Assurance			
Audit	Continuous Audit		In scope	In scope
Monitoring	Continuous Monitoring		In scope	In scope
	Process Data	Financial Data		
		Non-Financial Data	In scope	In scope
	General IT Controls	Logical Access	In scope	
		Physical Access		
		Back-up and Recovery		
		Change Management		
	Internal Control System		In scope	In scope
	Enterprise Risk Management System			

V. RESULTS

The overall outcome of plotting both pilots including the reference pilot is that the overall average maturity level is nearly stage 3: Monitoring. Stage 4: Continuous Audit has still not been achieved yet.

There are limited pilots and studies with sufficient detailed data and information available to plot the results and outcome on the AMM. The analysis of the two projects makes clear that the research on CM and CA is still scarce and in maturation and mainly related to non-financial data. Both pilots used for this experiment are related to CM of non-financial data. CAss and CRe are not part of the selected pilots. No pilots or studies based on actual implementations have been set up to perform research in the fields of CM, CA, CAss and CRe as one holistic and fully integrated process. To achieve a successful implementation of the continuous concept it requires an integrations and alignment of all elements of the chain from the start of selection of the data until providing CAss and deliver CRe.

VI. FUTURE RESEARCH

There is an increased need and growing pressure from stakeholders for receiving a continuous flow of assured data and information, specific non-financial data will become more relevant. Compliance, new laws and regulations will become applicable requesting assurance services of financial and non-financial data. As example the development of Corporate Sustainability Reporting, the EU regulation applicable as of 2025 regarding Environmental Social and Governance (ESG), the monitoring of General Data Protection Regulation and current developments regarding Process Robotic Automation. All these new developments included reporting reliability of financial data as well as non-financial data.

CCM can be applied to achieve insight in the existing level of assurance, to make the internal audit function more efficient and possibly, more effective. Auditors are skeptical about reliability of automated controls. There is a need for general audit and assurance models which fit system-based auditing approaches and a Continuous Integrated Assurance

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Concept for financial as well as non-financial data. Further research is needed, e.g., blockchain solution, to increase the reliability of the data, financial as well as non-financial data, and the overall level of trust. The outcome could be used to fine-tune the AMM.

New guidance and standards should be defined and implemented in close cooperation and partnership with the developers, producers, users and end users of CM, CA, CAss and CRe to control and manage the levels of expectation.

Further research is needed to get insight in the bottlenecks of why CA has yet not as a fully holistic process been implemented.

VII. CONCLUSION

The overall outcome was that the average maturity level for CM and CA reaches nearly stage 3: Maturing.

No research was performed based on a holistic and fully integrated process including the status and maturity level of the Line of Assurance at the client.

Limited research has been performed on CMM, CM, CA, CAss and CRe of financial data.

A certain minimum level of the LoA at the client will be required to implement CMM, CM, CA, CAss and CRe.

The holistic and fully integrated process could be very helpful for organizations accountable for reporting of sustainability, non-financial data across the organizations, e.g. usage of CO^2 in the supply chain process or energy process, waste water management, employees (own) and contractors Lost Time Injury Frequency Rate (LTIFR). Research could be performed in combination with automated audit standards is an option to achieve continuous assurance across the organizations and their business processes.

To meet the upcoming requirements of CM, CA, CAss and CRe a comprehensive holistic and fully integrated approach would need to address Line of Assurance testing, CCM testing, continuous internal control testing, continuous data testing, continuous transaction testing and continuous assurance testing.

The AMM could support academics by research and the business by further development of new IT concepts and IT solutions.

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TABLE IV. AUDIT MATURITY MODEL

Stage	*Stage 1*	*Stage 2*	*Stage 3*	*Stage 4*
Domain	*Traditional audit*	*Emerging*	*Maturing*	*Continuous audit*
Objectives	- Assurance on the financial reports presented by management	- Effective control monitoring	- Verification of the quality of controls and operational results	- Improvements in the quality of data - Creation of a critical meta-control structure
Approach	- Traditional interim, and year-end audits	- Traditional approach with some key monitoring processes	- Usage of alarms as evidence - Continuous control monitoring	- Audit by exception
IT/Data access	- Case by case basis - Data is captures during the audit process	- Repeating key extractions on cycles	- Systematic monitoring of processes with data capture	- Complete data access - Audit data warehouse. Production, finance, benchmarking and error history
Audit automation	- Manual processes & separate IT audit	- Audit management software - Work paper preparation software	- Automated monitoring module - Alarm and follow up process	- Continuous monitoring and immediate response - Most of audit automated
Audit and management sharing	- Independent and adversarial	- Independent with some core monitoring shared	- Shared systems and resources with natural process synergies	- Purposeful parallel systems and common infrastructures
Management of the audit function	- Financial organization supervises audit and Matrix to Board of Directors	- Some degree of coordination between the areas of risk, auditing and compliance - IT audit works independently	- Internal Audit and IT audit coordinate risk management and share automatic audit processes - Auditing links financial data to operational processes	- Centralized and integrated with risk management, compliance and SOX / layer with external audit
Analytical methods	- Financial ratios	-Financial ratios at sector level / account level	- KPI level monitoring - Structural continuity equations -Monitoring at transaction level	- Corporate models of the main sectors of the business - Early warning system

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