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Digital services governance: IT4IT™ for management of technology

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Abstract

Purpose – The purpose of this paper is to present, analyse and demonstrate the impact and potentials of a pragmatically derived information technology (IT) governance framework, IT4IT™, for the discipline of management of technology (MoT) especially within the IT industry.

Design/methodology/approach – This paper is based on an extensive literature study working with the limitations of the relatively recent publication of IT4IT™ and the normative character of IT4IT™. A mixed-method case study is presented based on an IT service provider organisation. Both a qualitative method and a systems and design oriented method are being used.

Findings – IT4IT™ can provide value and a clearer understanding of the service delivery framework if the technological core of the focal organisation is adapted to a value stream thinking. This suggests a more operational character of all IT processes and analogue to general MoT frameworks and corporate governance models.

Research limitations/implications – Given the recent publication of the IT4IT™ framework, this study is primarily *ex ante* and suggests further full-scale *ex post* research in the future.

Practical implications – Validation and successful implementation of the IT4IT™ framework will give companies better opportunities for safe and controlled value creation using IT. Control connects with risk reduction and less risk can encourage innovation and “tame” development complexity. Using value streams will align IT better with manufacturing and services.

Originality/value – Companies are striving to seek governance and risk minimisation in IT development and operations. This paper is discussing the applicability of the IT4IT™ framework for finding a better understanding of the value creation and value proposition delivered by introducing controlled processes minimising risk.

Keywords IT4IT, IT service management, Management of technology, Digital business creation, SIAM

Paper type Research paper

1. Introduction

The digital transformation is central in most industries as an established or perceived game changer for business models and as the most strategically technological priority (Ba and Nault, 2015; Westkämper and Walter, 2014; Kodama, 2014). Information technology (IT) is a locomotive for many new industries and business models with technology penetrating areas of business hitherto not affecting by technological innovations (Rossignoli *et al.*, 2016; Candi, 2016). Digital business models and disruptive innovations have become synonymous at least in a popular perception (Song, 2017; Tongur and Engwall, 2014).

Proper outcome of development, implementation and service orientation of digital initiatives is strategically determining in existing and emerging industries (Park *et al.*, 2014; Lepmets *et al.*, 2012). Despite the criticality of IT, IT development projects are generally regarded to be high-risk (Standish Group, 2016) pertaining to cost overrun, lack of quality and delays. In a management of technology (MOT) perspective, transition from development to operations of digital solutions is especially complicated as it involves a non-transparent fabric of technological and organisational processes across multiple or

Q1

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numerous organisational entities (Cetindamar *et al.*, 2009; Sarkis *et al.*, 1995). Life-cycle management is unclear, and generally being difficult to measure (McNaughton *et al.*, 2010; Berman *et al.*, 1994). As a core technology of modern business, MoT approaches seem obvious to harness and guide processes of IT (Gaimon, 2008).

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IT, as a technology, has largely, to this day, been controlled by “soft” governance frameworks such as project management systems and service management systems more being pragmatic normative constructs than actual business model foundations for IT organisations (Mesquida *et al.*, 2012; Kumbakara, 2008; Lee and Om, 1994). IT has until now, in many ways, been regarded as exempted from the structuration and automation represented by IT itself. Several frameworks suggest that IT governance is critical in obtaining predictable positive outcomes of investments and cost, such as COSO, ITIL, COBIT, BiSL, ISO27000, MOF, CMMI and TOGAF (Ali *et al.*, 2013; Lucio-Nieto *et al.*, 2012; Melendez *et al.*, 2016; Berrahal and Marghoubi, 2016; Tsunoda *et al.*, 2017).

Q2

The IT4IT™ framework released by The Open Group in October 2015 suggests to a major change (Josey, 2015; Moore, 2016; Morlitz, 2016; Ng, 2016). IT has to be governed and structured along defined processes of value chains, life-cycles, service propositions, customer interaction and cost control as any other area of the organisation. In simple terms, IT4IT™ propose to think IT services produced like well-defined products in a modern factory (Westkämper and Walter, 2014; Schrader and Droegehorn, 2016).

The purpose of this paper is to review IT4IT™ as a practical implementation of a MoT framework and to review its perspectives and implications to the MoT society as well as the contributions it has to IT professionals, innovators and MoT practitioners.

Motivated by IT as a key transformational technological force in most organisations, and motivated by IT4IT™ as a suggestion for re-thinking corporate IT services, the research question of this paper is:

RQ1. How should the IT4IT™ framework be interpreted as an MoT framework, with respect to the dualism of IT as both innovation driver of the business, but also IT as focal in development and operational resources spend in the organisation?

Furthermore, this paper emphasises that with IT4IT™ as a suggestion for introduction of value chain processes in the IT value chain reaching from idea to operations, whereas earlier frameworks (e.g. PRINCE2 vs ITIL) have focussed on either development or operational processes. Thereby, the research lens of this paper is the assessment of IT4IT™ as an unbroken chain of value creation bringing IT closer to manufacturing theory and practice.

2. Literature study

This literature study is first presents the foundations of MoT in order to establish the referential relationship to the technological framework. Second, this section presents IT service perspectives in order to define IT as a broader and more complex technology than computing. Lastly, this section is presenting the IT4IT™ framework. The underlying claim of the literature study is to support and pinpoint a research gap in the perception of MOT being unrelated to industrial frameworks for design, development and operations of technology. Furthermore, the literature study is aimed at finding support for a general split of IS (read:technology) frameworks in development and operations. This split is a risk for failure of innovation. The research gap to address in the literature study is henceforth, why development and operations remains split, and what characteristics and success criteria an empirically driven framework IT4IT™ would need to meet to fulfil to offer an end-to-end framework for technology.

2.1 Management of technology

MoT predominantly addresses strategic considerations of technological systems of the enterprise (Shalley and Gilson, 2017; Kerr *et al.*, 2013; Phaal *et al.*, 2004, 2006). However,

MoT must be as a broad discipline to manage technologies also at a tactical and operational level, or at least design tactical and operational systems (Lucio-Nieto *et al.*, 2012; Alter, 2014b). MoT typically addresses the life-cycle of technologies in the line going from early innovation up to the implementation, operations and end-life matters (Kim, 2013), although MoT just a frequently stops before manufacturing. Complementary to MoT life-cycle orientation, operations management address the cycle of value creation in the operational longevity of technology expressed by value chain management and discussions of business model creation (Kattenstroth and Heise, 2011; Tongur and Engwall, 2014). Kim (2013) moreover discusses the phenomenology of technologies using the Gartner Hype Cycle that describes technologies out of public professional interest and current perceptions on solving future anticipated problems. Hype constitutes both a driver and a bias in MoT (Berg *et al.*, 2014) where the governance structures must deal with a more system fact-finding and decision-making process.

Enterprises must act in distinctive elements of design and engineering to ensure meaningfulness in the relation between organisation and technology (Mesquida and Mas, 2015; Sarkis *et al.*, 1995), hereby emphasising MoT importance in the practice. Shalley and Gilson (2016) pinpoint MoT as the discipline of balancing creativity and innovation towards operations and standardisation. This is followed by Gaimon (2008) in a more general introduction to MoT and operations management as tightly connected and mutually dependent in aspects such as technological acceptance and diffusion, adoption of new manufacturing technologies, and technologies affected by and affecting innovation capability and knowledge management (Kirkman, 2016; Skaggs *et al.*, 2012). Noh *et al.* (2017) suggest a data-driven model for technology evaluation and MoT.

Lindén (2013) suggests a model for MoT of IT/ICT encompassing the breadth of disciplines within corporate practice such as considerations for strategic directives, purchasing and a technological assessment of a range of elements constituting IT, such as hardware, software, integration and operations.

Information systems (IS) make up a strong load within the investment budget of many organisations, and return-of-investments is often overly difficult to calculate (Shrestha *et al.*, 2013); MoT must be organised to ensure balance between the economic dimension of IT investment and the organisations ability to embrace new and promising technologies (Ba and Nault, 2015). Berman *et al.* (1994) express MoT as operating a set of strategic levers within the enterprise to ensure technology–strategy integration and alignment, especially activities of planning, organisation and control.

Thinking “frameworks” is deeply integrated in MoT research (Beard, 2002; van Wyk, 1988) with an MoT framework aiming at technological function, performance, principle and general features. People, task, technology, structure and strategy are connecting points in the analogue framework (Lee and Om, 1994). Kerr *et al.* (2013) highlight MoT as processes of identification, selection, acquisition, exploitation and protection vs strategy, innovation and operations. Furthermore, Kerr *et al.* (2013) suggest practical toolkits for governance and inclusion consisting of elements of human-centric approaches, workshop-based, neutrally facilitated, modular, scalable and visual. Many classical framework approaches have suffered from overemphasis on tangible technologies. Services connected to tangible technologies and service-based technologies are somewhat overlooked (Martin and Daim, 2012); services are related to a broad range of technologies from telecommunication, information exchange, digital businesses, advanced industrial services, as well as typical manual services with elements of technology like care, teaching, cleaning, gardening, etc. (Chang *et al.*, 2014).

As exemplary of one specific technology that penetrates more sectors and attracts more interest than most other technologies is IT. IT is regarded by most a key innovation driver, often expressed as “digital transformation”, but, at the same time, a highly persistent and

static part of the corporate infrastructure (Gardner *et al.*, 2016; Iden and Eikebrokk, 2013). This leads to a position of IT as both being of innovation and development and, at the same time, operation and maintenance. Often, this has been formulated as an ambidextrous capability (Chang *et al.*, 2014). MoT and MoT frameworks must support research and practice in safely coordinating the two positions in an economic way, emphasising risk reduction and process performance.

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2.2 IT and services

Services are identifiable abstractions of, mostly, human work and human intervention using a relatively broad set of skills and competencies (Tapandjieva *et al.*, 2017; McBride, 2009; Kans, 2013). Services are closely related to human work that both rely on services but also produce services in work-systems (Alter, 2014a, b). In this context, work and services will be closely linked to technology and service creation on the basis of technology (Ulbrich and Schulz, 2014; Rennung *et al.*, 2014; Mora *et al.*, 2015). In IT and IT-based business development, the concept of service has several meanings often with a transcendence between professionally defined concepts and colloquialism, a.o.:

- (1) human advice and intervention, like a service desk (Kekkonen and Arasmo, 2016);
- (2) the perceived quality of interaction, like “a polite service”, or “bad service” (Mesquida and Mas, 2015);
- (3) technical features and available utilities, like a network connection (Mesquida *et al.*, 2012); and
- (4) information, information exchange, information provision, like the weather report (Warfield, 2016).

ITIL and the IT service management philosophy define a services hierarchy as (Kasulke and Bensch, 2017; Cruz-Hinojosa and Gutiérrez-de-Mesa, 2016; Lucio-Nieto *et al.*, 2012; Wulf *et al.*, 2015; Andenmatten, 2016b; Cots *et al.*, 2016):

- (1) service strategy;
- (2) service design;
- (3) service transition;
- (4) service operation; and
- (5) continual service improvement.

Service design and service operations are typically translated into ITIL core services (Ali *et al.*, 2013), where ITIL has gone from a pragmatic framework into a global standard. Core services are:

- (1) incident management;
- (2) problem management;
- (3) change management;
- (4) release management; and
- (5) configuration management.

As services constitute the configuration of tangible as well as intangible assets, the services have to be registered in a configuration management database (CMDB) (Wu, 2014). The CMDB is useful as a reference for services and portfolios making up the architecture. However, CMDBs are demanding to maintain, and may be unprecise. CMDB

might, in the future, be more precise and interesting as they can be machine-generated, and rightfully designed, and can provide the reference architecture blueprint for automated service definitions.

IT is commonly organised as development activities vs operational activities. TOGAF and more frameworks describe and govern development (Tambo *et al.*, 2016; Betz and Jahn, 2016). Development activities are often emphasised along with general corporate innovation priorities, and IT investments must be reviewed as both innovation and maintenance of existing capabilities to keep up with change (Peters *et al.*, 2016; Candi, 2016; Jaw *et al.*, 2010; Kießling *et al.*, 2010; Lusch and Nambisan, 2015). An over-arching management system pinpoints project and portfolio management focussing on resource allocation and management of time and money invested (Vesterinen, 2015; Wang, 2016; Jolly, 2003). Operations are, in professionalised environments, often organised as services unrelated to development following the mindset of the ITIL framework (Cruz-Hinojosa and Gutiérrez-de-Mesa, 2016; Keel and Hodges, 2016); however, the literature also questions separating operations and development.

IT operations, over the last 15 years, generally adopted a service-thinking in concepts like “service oriented architecture” and “IT service management” (Berrahal and Marghoubi, 2016; Cots *et al.*, 2016). However, the actual meaning of service is highly different from context to context, and it does not provide a specific rationale to state that existing IT delivery models are fully service-enabled (Curry, 2014; Jia and Reich, 2013). Service might though provide a useful level of abstraction for standardisation and structuration, and, within this, also useful services as building blocks in establishing corporate systems architectures (Keel and Hodges, 2016). Archimate® is an example of a modelling language supported by several vendors that can represent a service portfolio adding to the enterprise architecture (Band *et al.*, 2015).

A fundamental of IT services is measurability. Services must be defined for expected outcome with associated relevant systems for measuring the performance or quality of the service (Betz and Jahn, 2016; McNaughton *et al.*, 2010; Lepmets *et al.*, 2012). Operational and transitional IT processes are connected by appropriate management practices generally known as IT governance focussing on best practices, corporate strategic alignment and standard operations procedures (Schrader and Droegehorn, 2016; Vlietland *et al.*, 2016; Bin-Abbas and Bakry, 2014; Bañuls and Salmeron, 2008). This must hold against IT as complex, risk-based and with difficulties in holding technology static without losing competitive momentum.

2.3 IT4IT™

IT4IT™ is a standard developed and managed by The Open Group (Daniel, 2016; Styles, 2016; Bañuls and Salmeron, 2008; Josey, 2015). The first edition was released in October 2015. The Open Group is a standardisation organisation mainly supported by a range of the largest IT companies. The Open Group has developed a range of technology standards within foundations of IT, e.g. UNIX, IT interoperability, e.g. ODBC, and processual guides such as TOGAF (Tambo *et al.*, 2016). IT4IT™ introduces a new style of thinking IT with specific aim of presenting IT as being fundamentally a tight knit combination of development and operations: like the process of developing and manufacturing a car; like an airline company; or like a chain of restaurants. The IT4IT™ position is making distance from the previous hard line of separating development and operations activities (Dashora, 2015), represented by frameworks like PRINCE2 and ITIL, respectively. Moore (2016) states: “The IT4IT™ Reference Architecture allows the IT function to operate as a business in its own right. It recognizes IT as a production-oriented business, a manufacturer of code. Consider this in the light of the software development function making or breaking a business [...]”.

More fundamentally, IT4IT™ is suggesting a position of representing IT from a value chain perspective (Walser *et al.*, 2017; Kattenstroth and Heise, 2011). A value chain that ranges from strategic requirements up until successful and ongoing operations is a value chain, and a value chain that ranges from detailed business requirements and opportunities to benefit realisation, like any other technology in the company.

The basic concept of the IT4IT™-defined value chain is illustrated in Figure 1.

Moore (2016) phrase IT4IT™ as an inevitable consequence of digital transformation of companies. When digital services become the foundation for the productive technologies of the companies, IT must be used to manage IT, such as IT can be used in management of a building or a vehicle. Andenmatten (2016a, b) emphasise that improvement in the development organisation and higher and faster precision of the service organisation is necessitating a common reference architecture with a joint information, functional and data model as suggested in IT4IT™ and illustrated in Table I.

Speed, reduced risk and cost efficiency are also suggested by Marimuthu and Venkatesan (2016). Even for legacy system architectures, IT4IT™ is proposing a “reinvention” of a high level of transparency, expressed as “Just as cloud is a disruptive force in technology platforms, the IT4IT™ Reference Architecture [...] is a disruption of existing operating models” (Morlitz, 2016).

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Source: Josey (2015)

Figure 1.
The IT value chain

Functional model	High-level definition of all functional areas for IT Based on customer use case analysis
Service model	Based on ITIL, service life-cycle and high-level grouping of: continuous assessment, continuous integration and continuous delivery – and later into value streams
Information model	Identification of key controlling IT artifacts Definition of artifact life-cycles according to life-cycle model
Foundational integration layer	Defines key control points for integration, based on artifact Link Information model with life-cycle model

Source: Price (2016)

Table I.
General approach
to the IT4IT™
reference architecture

2.4 Theoretical model and research gap

The three theoretical foundations of this study are presented above: MOT, IS/services and IT4IT™. As set out in the research question, IT4IT™ is reviewed from its ability to provide meaningful interconnect between development and operations in the IS field alongside contrast itself with MoT, thereby understanding MoT as guiding for the overall efforts and initiatives of the company. To this end, industrial and empirical frameworks like IT4IT™ are then interesting to review from their ability to provide a meaningful and sufficient explanatory basis for transformation activities of the company. The assumed research gap is this field is hence the receptiveness in theory and practice of new introductions of end-to-end technology management frameworks IT4IT™.

3. Methodology

This paper is based on a qualitative, interpretistic and sociologically-inspired methodology in the tradition of IS studies (Walsham, 1995). Practice of relevance is underscored in the case study with an IT/IS providing organisation and its stakeholders (Benbasat and Zmud, 1999). Action research not only plays a significant role as the organisation and sociotechnical systems are affected by the study practices, but also reacts upon the imposed changes (Baskerville and Wood-Harper, 1996). The main case relies on a major case study with five months of in-depth, daily effort to observe, collect and structure data (Yin, 2013). The data collection approach consisted of daily observations in the work environment, participation in internal project meetings, interviews with customers or customer representatives, system design and modelling, model creation in BPML, UML and ARCHIMATE/TOGAF. The tradition of studying technology from its constituting structures is followed (Orlikowski, 2008).

Empirically, this paper is based on an extensive case study of a large IT service provider (Tambo *et al.*, 2016; Aramand, 2008). The IT service provider used the framework, along with other frameworks, to introduce larger degree of homogeneity of its own service “catalogues” (Kumbakara, 2008), improved processes for navigating in the heterogeneous of its customers, and to ensure uniform processes of performance management and reporting (Lepmets *et al.*, 2012). The empirical data collection was conducted during February–May 2016, and consisted of one co-author’s full-time presence in the organisation. During this period, three or four key stakeholders of the three main clients (banking, food and transportation industries) of the service provider were interviewed two or three times. The key stakeholder from the service provider’s side was the customer service manager (CSM). The CSM had core team of approx. four persons for designing, coordinating, delivering and measuring the services. The clients had likewise a team of one senior manager with specialists in e.g. network and security, service requirements specification, and legal advisors. For the implementation of the service architecture, a team of around six persons worked in service design, architecture development, metrics specification, metrics (business intelligence) implementation. All stakeholders and participants were interviewed or their roles and positions were recorded along the technical specifications and designs. As some team associates had minor roles and some had multiple roles; the overall team followed by this project had around 20 persons. Along with interviews, meetings, communication, relationships, knowledge positions and technical efforts were used as data sources. Technical efforts are to be understood as technical skills, insights in the service providers’ infrastructure and capabilities, insights in the customers’ infrastructure and service requirement, and actual models and systems developed and put into production.

Methodologically, this paper has been challenged by the novelty of the topic of IT4IT™ as few peer-reviewed materials are available. A broad range of analogue communication channels therefore had to be reviewed. This included among others standards, whitepapers, blog postings, student works, professional presentations, webinars, online training materials

and Youtube videos. Methodologically, new topics initiated phenomenologically or, as in this case, as a new standard, must fight the weakness of absence of prior work that is challenging the precision of the findings and outcomes. This effort has brought a range of materials that positively has supported the knowledge collection process. The main criticism within this approach includes: unsubstantiated commentaries (blogs), vendor bias and absence of scientific foundations. These three issues have all been taken into account and, eventually, the reference base of this paper is predominantly scientific materials.

A limitation of this study is that IT4IT™ is seen from the service provider's side, and not from the focal organisations side. The service provider has earlier been integrated in a consuming organisation, and has first recently more visible role in the general market. The former role of the service provider improves the likeliness of outcome to focal organisations in general. The service provider is engaged with a range of larger enterprises in Northern Europe. In this role, the service provider is exposed to trends and operating styles in many different industries, thereby suggesting a higher validity of the findings. Representatives of three larger customers were interviewed as a part of the study: a food production company, a company in public transportation and a financial institution. These interviews approved the changes in the service offerings of the company described below. The three companies therefore provided a triangulation of the results in assurance of the practical and theoretical reproducibility and viability of the presented data, analysis and results.

4. Case study

Pollux is a major Northern European IT services provider that employs approx. 2,500 IT professionals. Pollux was spun-off from a larger research and manufacturing organisation in the life-science industry and was introduced at the stock market around 2015. The IT services are mainly in the field of IT infrastructure operations, software systems operations and management, help- and service desks, standard software implementation, application management, cloud services, clients and database management. Industries of focus are larger industrial enterprises, governmental services, healthcare and life science, and the financial industry.

Pollux have had a process of departing from its originating organisation and aimed at taking new, larger, professional customers on board. A customer engagement could start at US\$1m pa and go up to US\$20m pa. A customer engagement is normally viewed over several years and thus the total contract amount ranges from 5m USD to some hundred million USD.

In the process of getting new customers, Pollux has been highly oriented towards documenting and measuring its performance at a very detailed level adapted to the customer's specific requests. These requests have been developed in the initial customer dialogue based on the specific focal services of the CSM and the customer's purchasers and decision makers. The combination and configuration of services have been adapted to customer requirement or perceived customer requirements at a very detailed and somewhat unsystematic level. The unevenness of service configurations for each customer has had consequences. Pollux's ability to deliver well-identified services has developed with the customer, and it has been difficult to utilise services and learning of services quality from one customer case to the next.

Pollux started in late 2015 an initiative towards harmonising services. Following the ITIL framework, the pool of services within the individual customer service contracts was tentatively merged into more standardised services. The purpose of the standardisation effort was expressed within the CSM forum as:

- establish patterns of activity as services entailing people, skill, technology and capability;
- standardisation as professionalization;

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- present and describe standardised services in a service catalogue along with a CMDB definition process;
- develop customer expectations and (produced) service level on the standardised services of the service catalogue;
- promote reporting and business intelligence offerings to customers according to standardised services rather than customised services, where this was not necessary; and
- simplify reporting and tentatively make reporting real-time and customer-driven.

The ideal outline of the operational model of services delivery of Pollux is illustrated in Figure 2.

Pollux is pursuing a major change in its way of producing IT services. The change will aim at connecting delivered services to the established and agreed service catalogue. To each service in the service catalogue, there is a defined reporting approach in line with a general effort of performance management. The management control in the form of standardised reporting is indicated at top level in Figure 2 and in a more detailed and process-oriented level in Figure 3. In this approach, Pollux ensures that processes in between have to transform to support the end-to-end reporting.

The transformation within Pollux is thus to change customer specific services into generic and standardised services. These services are supported in the service management catalogue. The service management catalogue specifies the KPI of the service level agreement that might be customer specific. The real-time monitoring collects data on ongoing service performance. The recording of the monitoring process can be used to generate standardised reports to the clients. Pollux is overall using its organisational experience going from one to many customers to approach IT services to a production process.

Pollux used the IT4IT™ mindset in the reorganisation of its services. As an infrastructure and application service provider, Pollux is neutral to both infrastructures and application vendors. The key value Pollux can provide to customers is problem-free operations and problem-free test and implementation of applications. In changes and transitions, Pollux might have an economic risk, if services fail or exceed cost. In having

Figure 2.
Integrated service
level management
architecture

standardised services, and in inviting customers of better organisation of IT development and services, the customers are also urged to streamline the value justification suggested by development activities, in having a value creation mindset that connects the key elements of the IT process chain is subsequent better for both Pollux and its customers.

5. Discussion

In studying MoT frameworks, a number of criteria must be defined to establish meaningfulness for management, technology and the concept of frameworks as processual blueprints for both academia and practitioners (Kim, 2013; Lee and Om, 1994; Tambo *et al.*, 2016; van Wyk, 1988). Fundamental to a framework, in general, and MoT frameworks specifically, is the ability to guide the governance process of technology up to a level of practical relevance. At best, MoT frameworks are to be considered as a reference model or a reference architecture in domain-specific technological processes (Lepmets *et al.*, 2012; Bolisani and Scarso, 1999). Frameworks must provide navigation in corporate practices (Beard, 2002), and navigation is found between static structures and institutions and the dynamics of change (Martin and Daim, 2012; Pardo *et al.*, 2013).

5.1 Case analysis and learning points

Key findings related to the case entail the desire of structure and value. The company was, for years, split between consultancy and classic “machine room” operations. The services sought by the market relate to highly professionalised, knowledge-intensive operational services. The transformation described in the case is seeking an amalgamation of the knowledge-based design efforts with the technology-driven operational performance.

On basis of the theoretical review in Section 2, the following key points are suggested as essential elements of research related to MoT frameworks:

- (1) the concept and implications of management must be defined;
- (2) technology must be definable and characterised in sufficiently generic terms, although technology must also be sufficiently concrete to be manageable;
- (3) life-cycles must be defined, from early innovation at idea and concept level and to safe and stable operations;
- (4) the framework must be communicable, scalable and teachable;
- (5) it should have practical applicability with relevant connection points to established operational frameworks such as the aforementioned COSO, ITIL, MOF, COBIT, etc.; and
- (6) assessment tools and efficiency metrics should be integrated.

With Beard’s (2002) framework, IT4IT™ is shifting “unorganised” IT services from the subjective to the objective, where the micro-level perception of IT services is changed to a macro level in using common reference architecture, and technology is used on technology rather than the “story” of technology is told and retold by stakeholders.

As Pollux changed from customised services to standardised services and defined itself more into the customer’s value chain, IT4IT™ presented itself as a blueprint for the actions taken. A number of outcomes came forward coherent between Pollux’ points of action and IT4IT™. Key takeaways followed by the observations leading to these findings are as follows:

- (1) More well-defined services including issues of less duplicates or almost-duplicates of the same services: this is derived from the introduction of a service architecture and a service catalogue (Kumbakara, 2008).

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- (2) Better alignment between competencies and services often with distinct competency mapping included in the service definition: this is following a defined service (product) ownership regarding senior management and technical competencies in Pollux' organisation; often, there is stated a "matrix" style of competencies for advanced and/or cross-cutting competencies, e.g. certified network engineers (Tapandjieva *et al.*, 2017; McBride, 2009; Kans, 2013).
 - (3) Better and more flexible use of competencies across customer engagements as competencies were explicitly defined, e.g. "Certified Information Systems Security Professional": any service is defined from technological and human resources required. The first is defined in the CMDB. The second is defined intrinsic in the service definition (Wu, 2014).
 - (4) Lower learning barrier on individual customer engagement and service level agreements: the service catalogue is identical across customer engagement and IT4IT™ is uniform (Kasulke and Bensch, 2017; Cruz-Hinojosa and Gutiérrez-de-Mesa, 2016).
 - (5) More professionalised image to customers who actually were asking for standardised services to obtain operational efficiency: the *ad hoc* style of bespoke service configurations of early days' customer engagements are on the long term regarded as "unprofessional" as customers must insist in transparency and efficiency from organisational learning within the service provider's organisation (Morlitz, 2016).
 - (6) A cross-organisational service catalogue: this artefact is inevitable of the establishment of the full life-cycle management of the deliverables (Josey, 2015).
 - (7) Simplified and more efficient reporting on customer services – both to the customers and internally: the projects, among others, originated from complex reporting to customers. IT service management tools representing the service portfolio is the operational context (Vesterinen, 2015).
 - (8) A deliberate reorientation towards more advanced customer services and relief in organisational load from simplification of "simple" services: moving from *ad hoc* services to standardised services do offload high specialised staff and creates more transparency and less dependency of individual staff members (Ulbrich and Schulz, 2014).
 - (9) A preparedness to create an overall service delivery architecture where internal IT services were directed towards the value chain support (Kattenstroth and Heise, 2011).
 - (10) A more manageable business: *ad hoc* solutions are converted to a configuration of standardised services reflecting the undesired characteristic of services being agreed directly between a service delivery manager and the client without improved buy-in from the whole organisation of Pollux (Curry, 2014; Jia and Reich, 2013).

The case of Pollux covers a range of service delivery methodologies from a large service provider to selected industrial clients based. The services delivery palette is developed over time out of the clients' needs more than the service providers' formal capabilities. The above list is pinpointing transitional opportunities for the service delivery activity.

5.2 IT4IT™ and management of technology frameworks

IT service management frameworks, such as ITIL, have inspired broad ranges of non-IT service management studies and governance models more generally discussed as business

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service management (Gardner *et al.*, 2016). Most theoretical positions see IT development as disjoint from IT services. IT4IT™ is suggesting a closer relationship. Up to 2015–2017, this was generally disregarded and found contradicting with best practices. Several methodologies now suggest such a closer interconnect in the delivery chain predominantly related to agile systems development methods (Vlietland *et al.*, 2016). DevOps has gotten significant attention but is not a service-operational framework. Andenmatten (2016a) do however suggest potentials in linking IT4IT™ and DevOps.

In having a systematic approach to activities of the organisation as standardised services, it was furthermore easier and more straightforward to identify the organisation as a producer or provider (contrary to consultant) within the value chain. Here, again, emphasising the value of IT4IT™ as a frame of discussion of general IT services being a manufacturing process in contrast to classic perceptions of IT services, especially development, as being a craft or an art. IT4IT™ adds to state of art in the sense that it connects design, development and operations in a single life-cycle, and it considers transitional stages in the life-cycle as a value chain.

Getting back to the MoT Framework consideration, and given the reflections on the outcome of Pollux, the relationship between MoT frameworks and IT4IT™ contrasted as shown in Table II.

IT4IT™ suggests itself to be a practical implementation of MOT frameworks especially in conversion from of relatively mature innovations to operational environments and life-cycle management. A critical position to this is the low level of maturity coming from IT4IT™'s relatively recent launch. Moreover, it is a discussion point if innovation processes of the enterprise are so precise and well-described that they can be transferred into a joint development-operations framework or needs further maturing. In discussing IT4IT™, there seems to be a dependency of relevance related to the complexity of the development processes, “Requirement to deploy”. Highly experimental and risk-based development activities seems less fitting to the framework than “low complexity” development processes. Moreover, as IT4IT™ contains elements of commoditisation of IT services and IT development deliveries, it is not clear how IT4IT™ can embrace shadow systems, non-IT IT-development, bring-your-own-device, sporadic business-driven Software-as-a-Service and likewise other commoditisation trends in the technology industry. IT4IT™ is driving IT further in the direction of commoditisation and consumerisation, reducing uncertainty in IT implementation and operations, and giving business stakeholders better opportunities for innovation. The better opportunities are coming more well-specified development activities stressing risk reduction. Several contributors comment on this relationship. Warfield (2016) pinpoints that IT4IT™ will ease the job of system architects as higher level of

Table II.
Contrasting MoT
and IT4IT™

MoT	IT4IT™
1 The concept of management must be defined	Reference architecture for management of IT technologies
2 Technology must be definable and characterised in sufficiently generic terms	Neutral to specific IT technologies
3 Life-cycles must be defined. From early innovation at purely conceptual level and to pure steady operations	Defines the cycle from inception to end-of-life
4 The framework must be communicable and teachable	Several MOOC's have been created and seminars and teaching sessions are made
5 It should have practical applicability	Contesting other frameworks like TOGAF, ITIL, COBIT. Time has to show
6 Assessment tools and efficiency metrics should be integrated	Metrics miss still some clarity, but SLA KPI reporting is well demonstrated

standardisation is a target in itself. Andenmatten (2016a) suggests IT4IT™ as a tool adoption of the DevOps development model. Likewise do several other authors pinpoint advantages in adopting IT4IT™ as structure, standards and a possibility for converging the general business operations and IT. This discussion is furthermore underpinning the general business trends of digital transformation thereby creating coherence between digital transformation as an ubiquitous trend of MOT in most industries and IT4IT™ offering itself as guiding for precision in the technological dimension of digital transformation.

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On the comparative position between MoT and IT4IT™, Table III suggests selected highlights of interesting fits between the four value chain elements of IT4IT™ and broad MoT areas of interest. Critical is to project this fit into proposals for organising operational practices and ensure analogy between IT services and e.g. general business services or physical manufacturing.

In critically discussing IT4IT™ several positions exist: Can we predict if IT4IT™ will get sufficient momentum in the industry? Is it duly reflecting the needs of the companies? Is it in the interests of IT departments and professionals? Can a relevant interaction between industry and academia actually gain momentum to emphasise the IT4IT™ – MoT dualism and ensure relevance to practice?

- (1) The viability of IT4IT™ is decided upon companies' willingness to invest, implement and operate. Shortly after the release of the standard came a range of e-learning providers. As of mid-2018, there are still few hits in job search databases and career profile networks, e.g. 1,800 hits in LinkedIn. Critical success factors would entail a job market, broad vendor support and implementations in larger scale with recognised benefits. The Open Group state 18 accredited training course providers in mid-2018 with more than 50 course providers found on the internet for both online and in-class training.
- (2) IT4IT™ is largely augmenting ITIL with innovation and development considerations. ITIL has gained a status a global *de facto* standard. This has taken almost 20 years. IT4IT™ is more complex so a relatively longer and more modest proliferation might be expected. A momentum for successful implementation would again require quantitative studies.
- (3) Pollux is a service provider of certain background services in the IT landscape. Pollux is neutral on the actual implementation in the customers' organisations. So far, IT departments have received IT4IT™ positively although hesitant.
- (4) IT4IT™ is useful in demonstrating an MoT practice in the form of managing technology life-cycles from idea to operations closely connected to a relevant value chain and also connecting the development cycle value chain with the operational value chain. A connection mainly overlooked by other frameworks focussing on either development or operations.

IT4IT™ process	General MoT process
Strategy-to-portfolio	Early innovation initiatives. Technology intelligence. Fuzzy front end. Open innovation (Song, 2017; Demirkan <i>et al.</i> , 2008)
Requirement-to-deploy	Innovation management. Early supplier involvement. Portfolio management (Kießling <i>et al.</i> , 2010; Lee and Om, 1994)
Request-to-fulfil	Implementation. User acceptance. Change management. Empowerment. Dynamic capability. Absorptive capacity (Berrahal and Marghoubi, 2016; Gaimon, 2008)
Detect-to-correct	Operations and life-cycle management (Tsunoda <i>et al.</i> , 2017; Ng, 2016)

Table III.
IT4IT™ vs MoT

To summarise, IT4IT™ proves itself academically interesting in the sense of suggesting a different and more embracing approach for business reorganisation for a more streamlined innovation-to-operations connection. Likewise is IT4IT™ worth practically to consider as a novel framework connecting value, development and operations in the line of general MoT frameworks.

5.3 Implications to theory, society and manufacturing

The introduction of IT4IT™ is envisioned to offer several implications to theory and practice. Theory of digital services is augmented with the aspect of a framework going from business incentive (idea) to operations where many other theories and frameworks are addressing development and operations as separate activities. The end-to-end or full life-cycle approach is affecting MoT theory in the sense that companies are getting a more specific solution with a set of more well-defined services, but might not be able to exploit innovations developed for similar companies in a different context. MoT theory must address the necessary openness of the implemented solution, the ability to incite and support innovation and the actual pace and robustness of the transition from development and into operations.

In this sense, IT4IT™ might lower the societal “threshold” for new services in the sense that the combined cycle of IT develop and operations should get simpler and likely cheaper when using standardised life-cycle methodologies. This can also be translated into a scenario of commoditisation with depletion of professional esteem and value as consequence and as a long-term projection.

A key learning of IT4IT™ in the above suggested context of using a life-cycle approach to IT, and a well-orchestrated application of measureable services is a convergence of IT and general manufacturing in most of its facets of innovation, development, transition and operations. This is supported in the trend of considering manufacturing as cyber-physical systems (Peters *et al.*, 2016) and trends of “Industry 4.0” and similar phenomena adding to convergence of information life-cycles and physical manufacturing life-cycles. Likewise are the potential implications to manufacturing of the stipulated service management approach entailing defined services based on defined systems configurations with standardised metrics.

6. Conclusion

Suggestions for further studies include seeing the impact of full value chain implementations of IT4IT™ and associated empirical studies. The Open Group is a forum for large influencers within technology and most standards have impacted industries positively over time. The Pollux case started at the end-points of the value chain in form of standardising the service catalogue, service level agreement KPI definitions and the reporting of the SLA KPIs. A number of suggestions are presented for an actual IT-based underpinning of IT4IT™, e.g. IT4IT™-based knowledge management systems, dedicated management IS, better connections between portfolio management, enterprise architecture, project execution, delivery management and continuous transformation processes. Not one system exists so far for supporting the full IT4IT™ value chain, but the reference architecture is preparing solid grounds for this. Further projections for research in IT4IT™ could address the modern-day strongly heterogeneous service landscape of IT, where the Service Integration And Management (SIAM™) reference model has been proposed to manage multi-vendor environments; SIAM indicates a potential for augmenting IT4IT™ and control inter-organisational complexities (Andenmatten, 2016b; Armes *et al.*, 2015).

Conclusively, IT4IT™ is taking IT a step further in being a more manageable technology with more specific definitions of services, customer expectations, relationships between innovation and operations, and transparency of processes. IT4IT™ suggests a highly

specific and novel interpretation of innovation and operations value chains that can inspire other MoT processes. Scholarly, IT4IT™ is new and lacks scale implementations; thus, this paper has an *ex ante* perspective, and longitudinal studies must be initiated. Furthermore, there are discrepancies and inadequacies that must be subject for further studies. The IT4IT™ framework is an interesting suggestion to the MoT society for a professional framework that has gone further in governance models and provides a more holistically approach than probably any earlier framework.

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Further reading

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