Service Level Management in Platform Ecosystems

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Abstract: With growing importance of e-service platforms, enhanced Service Level Management (SLM) concepts are required, paying respect to the service providers' autonomy as important source for value creation within a platform ecosystem. This paper proposes a highly automated SLM concept, wherein traditional direct control mechanisms are complemented by indirect mechanisms, including reputation systems, selected motivational measures and information-based guidance of each individual service-provider. The concept makes use of the ecosystems' inherent emergent and self-organizing processes and is grounded on system and control theory.

1 Introduction

In academic literature, Service Level Management (SLM) is referred to as a regulatory process of defining, implementing and verifying SLAs in pursuit of optimal goal accomplishment in dynamic environments [BT05]. With the growing relevance of e-service platforms as centerpiece of collaborate value creation for composite services (e.g. eBay, Netsuite, Facebook, Apple App store) this conception of control in service level management requires revision: The two areas of service level management, service quality management and service portfolio management [SB08], need to take account of new processes of decentralized value generation in platform ecosystems through autonomous service providers. These processes cannot be reduced to a simple outsourcing decision, but they are rather part of renewed strategies of open innovation. In order not to suffocate dynamics and creativity, an optimal trade-off needs to be found between direct hierarchical SLM and an indirect rather guiding complementary approach to SLM. The research goal is this paper is to present a concept for automatable optimization of service offerings in terms of portfolio and quality based on actual requirements by financially important consumer groups.

Motivated with system theory and based on feedback control (section 2), we therefore present a reference architecture (section 3) in support of automated goal congruent SLM in platform ecosystems. In section 4, we describe the required control mechanisms to accomplish the said research goals. In this paper, we have a closer look at those control mechanisms, which promise strong reactivity through emergent self-organizing processes, namely Informative and Motivational Control.

Until today, only little consideration of these mechanisms can be found in state-of-the art research and industrial application in the field of SLM. Related research, in terms of automatic reasoning support and in the context of ecosystem based value generation is done by the e3value community [OB09, AB04, DG08]. However, their perception on centralized service bundling is reflecting the autonomous and decentralized value generation approach of leading e-service platforms. The same exclusion criteria apply on ontologies from a business process modeling background such as the Service Network Notation (SNN) [BDH08].

The following concepts have been derived epistemologically by applying system theory onto SLM of platform ecosystems. Prototypes for the reference architecture and for consumption clustering (section 3) were developed in the research project 'SVN' in cooperation with SAP and in the overall frame of Theseus / Texo. The reference architecture was published by [FSS10].

2 Theoretical Foundation

In the context of IT-service-platforms, composite services can be described as the outcome of service value networks (SVNs); SVNs on the other hand can be regarded as a consumer-driven instance of a business ecosystem, consisting of a service ecosystem of autonomous service providers and (clusters of) consumers interlinked through relations and transfers of value [FSS10]. With growing portfolios of services, service enablers and transaction types, system complexity becomes difficult to be handled. The picture even aggravates, when system dynamics and evolution are taken into account. Which theoretical embedding is the most suitable to capture complexity and able to supply concepts to cope with it?

Dynamic business ecosystems are characterized by a continuous flux of new entrants and exits of service providers under strong influence of external stakes such as competition. To pay respect to prevalent dynamics in value networks [BM00] and to the autonomy of service providers we apply system theory. System theory, as pioneered by researchers such as [WN48, VN66, and PN77], tries to capture complexity, self-organization, connectionism and adaptivity in systems. Its proximity to non linear control theory [FO90] allows us make use of control concepts to actively influence ecosystems towards system optimization. Two important system-theoretical phenomena that we will further build on are 'emergence' and 'self-organization' within an ecosystem. Self-organization describes the dynamic and adaptive increase in structure of service ecosystems without external control [DW05], driven by each service provider's individual pursuit of profit maximization. Emergence describes a novel and coherent macroscopic behavior of the ecosystem as a result from the interaction between the service providers [DW09]. It leads, due to the absence of central control, to a reduction of complexity w.r.t. individual interaction, in particular for the platform provider. Such a continuously adapting system, also called "far-from-equilibrium system"[PN77] is "more fragile and sensitive to changes in the environment but in consequence also more capable to react" [DW09].

To limit complexity with regard to portfolio management, many of the players in these markets have introduced degrees of decentralized control respectively autonomy to the service enablers e.g. Salesforce, Netsuite, the Apple App Engine or Facebook [SS10]. Giving up much of the shaping influence on product-mix and reducing it to substantiating services, migrates value creating activities into the service ecosystem. For the platform provider, focus shifts towards federation of capabilities. Cooperation happens based on real time flows and integrated IT systems [CG05]. However a mix of direct and indirect control is necessary to insure quality of service and coherent ecosystem evolution w.r.t. the platform operator's strategic goals [SS10].

3 Control Theoretical Reference Model

In the frame of the SVN project, our team developed a feedback-architecture for continuous system optimization (see fig. 1) [FSS10]. In this architecture, we suggest monitoring selected features and phenomena of the entire business ecosystem (e.g. service successability, service consumption patterns, SVN topology). The business ecosystem is thus turned into the control path of a regulatory process. Monitoring includes consumption and consumer preference data, as well as data on the chosen services.

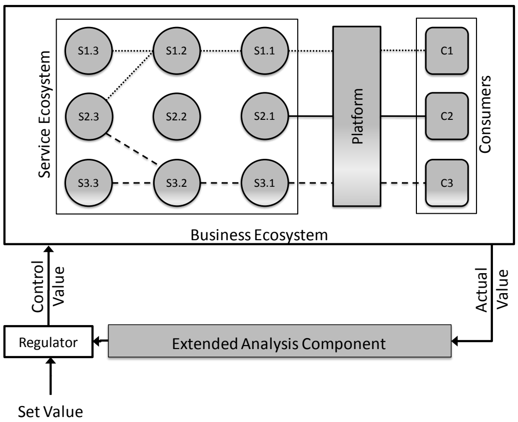


Figure 1: Feedback Control System (based on [FSS10])

Consumption clustering correlated with the clusters' respective financial importance allows the platform provider to gain relevant information on important user groups. Assume the following use case of service portfolio management: A platform provider detects an important consumption cluster for accounting services. However his service portfolio is underdeveloped in this segment. His goal should hence be to guide the ecosystem in a targeted way in order to fill this gap. This guiding task is accomplished by the regulator (fig.1). Let us now shift to a use case in the context of service quality management: the platform provider detects that his business service consumption clusters require minimal availability of 99.98%. He will hence use the same regulator to influence the ecosystem to fulfil this minimal expectation.
The functions of such a regulator will be explained in chapter 3.

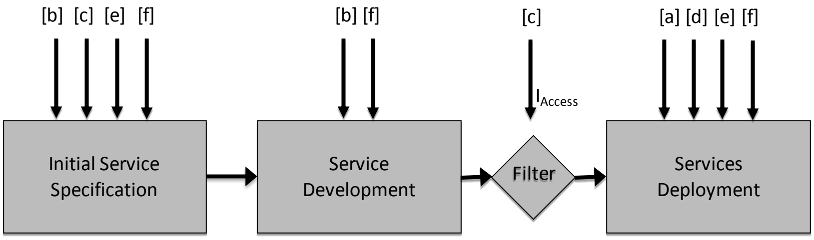
From a system theoretical point of view, the regulator uses the offset between analyzed actual value and set value to actively influence the ecosystem. To do so, it further modifies the offset into a ‘control value’ U, dedicated to steer the ecosystem in an optimal way towards the set value. The control value can be considered as a vector of signals, interfering with the system at various toeholds. Because of a steady change in the external environment respectively in the consumer preferences, the offset evolves over time. The respectively evolving input into the regulator incites rapid re-leveling of the system, i.e. of service portfolio and individual service quality. The underlying mechanisms within the regulator are subject of the following chapter.

4 Control Mechanisms

The regulator has to steer the service ecosystem respectively its services towards goal congruence with respect to service quality and service portfolio. To do so, it is equipped with a toolset of control mechanisms for SLM in ecosystems. They have been formulated as a result of explorative studies on successful platforms, condensed to six mechanisms in pursuit to avoid overlaps [SSF09, FSS10, SS10]. Fig. 2 shows, where the mechanisms leverage the services. The 3 sections of service leverage represent a flexible product-development process in the context of Internet-based deployment as suggested by [IC99], structured into initial specification phase, service development phase (which through iterations embraces also the subsequent maintenance phases) and the deployment phase. The first mechanism, Market Regulative Control (a) describes consumer-based service verification and auditing; it finds broad application in service platforms through reputation systems and triggers self-optimization of the ecosystem through publicly displaying (perceived) service quality (‘badging’) [SS10]. Co-regulative Control (b) comprises guiding principles of service development, providing development rules or tools for coherent service supply and observability of quality parameters. Conjointly with Restrictive Control (c, platform access regulations depicted as a filter in fig.2) and Sanctional Control (d, coercive action up the exclusion of services or service providers), it creates a sequence of regulative and subsequent enforcement mechanisms. An illustrative example is EBay’s Verified Rights Owners Program, where in case of a risk of copyright infringement, an escalation routine is started which can lead to the highest grade of enforcement, the exclusion of an offer respectively provider [SS10]. Also market regulative control is sequenced with the described enforcement mechanisms; e.g. in cases where quality ratings show that a service does not meet the platform’s quality standards, similar escalation routines can be applied. These control mechanisms can be classified in the group of service quality management tools.

The remaining 2 mechanisms, Motivational Control (e) and Informative Control (f) indirectly steer the ecosystem. Whereas information control leverages service quality and service portfolio, motivational control focuses on the service portfolio. Informative Control (f) counteracts information asymmetry[1].

[1] The term ‘information asymmetry’ originates from the New Institutional Economy, describing unequal distribution of information between a principal (platform operator) and an agent (service provider) [WO81].



[a] Market Regulative Control [c] Restrictive Control [e] Motivational Control

[b] Co-regulative Control [d] Sanctional Control [f] Informative Control

Figure 2: Toeholds for the regulator's control mechanisms

Each individual service provider is supplied with information on consumption clusters of services similar to his offer (gained through automatically detected preference clusters with the help of standardized service descriptions, e.g. based on the eClass-standard[2]), on the clusters' economic relevance and on the service provider's involvement respectively non involvement in invoked composite services. Let us take the example of a low-performing provider of online accounting services, conform to the US-GAAP-standard. The consumption cluster analysis shows a financially important cluster in book-keeping, however, the cluster analysis highlights that (due to mainly European and Australian customers) conformity to the International Financial Reporting Standards (IFRS) is required instead of US-GAAP. The provider receives feedback, customized on his specific service offering "accountancy", informing that financially relevant preference patterns deviate w.r.t the legal reporting standard. It is then up to the service provider how to react on the feedback. In view of customized feedback to every provider in periodic loops, the service portfolio will evolve based on the ecosystem's self-organizational efforts. Similar processes will take place in examples of service quality, e.g. service availability that is below the preference range of the respective target group.

Based on the consumption cluster analysis, automated feedback can give guidance on which of the functional and non functional quality parameters in an offered service need to be improved to increase the probability of being part of successful value nets. The advantage of informative control is that it is from an economic point of view resource neutral to the platform operator. Its application promises improved service quality and better aptness of the overall service portfolio on the consumers' preferences. Supplying feedback in a customized way to each service provider accelerates the emergent self-organizing process, as all service providers get a clear picture on consumer preferences and potential steps towards profit maximization. The platform and its service portfolio can thus rapidly adjust to new market conditions. This approach however does not allow for steering the service ecosystem towards strategic goal congruence w.r.t. the platform operator's service portfolio. To support a coherent development of the service portfolio, motivational control will be the suitable mechanism.

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[2] www.eclass.de

Motivational Control can be accomplished though development support, community building, subsidized access to the service ecosystem, open license models for specific code, but also through monetary motivation such as seed funding. I.e. Facebook or the Apple App store co-finance best performers in specific segments in a spotlighted way and with the intention of attracting a spate of followers towards underdeveloped subject areas. With regard to the increase in order we can assume a non-linear reactivity of the ecosystem on motivational control. An example will make this abstract phenomenon more tangible: Let us assume the platform provider has the strategic goal to attract more US-clients and he sees critical importance in US-GAAP based finance services. He provides sufficient seed capital for selected service ideas paired with accentuated visibility. When a stimulus reaches a critical level (breakthrough-level), the ecosystem will react and emerge towards a new level of order with more US-GAAP based services. Being a non-linear process, the new level of order will sustain or only slowly decrease, even though the stimulus is reduced, until a second critical level (break-down level) is reached. If the new services are adopted, the fading stimulus of capital injection will be replaced by a second stimulus of purchase by the new US-customers. In fig.3, we simulated this with the Preisach model [PA04]. It shows a response curve of service providers, deploying new services in reaction of the platform's financial stimulus. At point 'A', the decreasing stimulus of capital injection is super-imposed by capital reflux from the consumers, purchasing the new services.

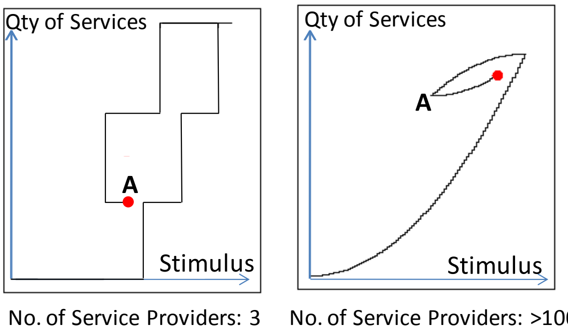

Figure 3: Hysteresis-like system response of services offered on stimulus; the initial stimulus is capital injection, at point "A" super-imposed by service consumption. 2nd simulator by [PA04]

4 Conclusion and Outlook

Within this paper, we emphasize that SLM in platform businesses requires a blend of direct and indirect control mechanisms. A sequence of regulative and enforcement mechanisms together with market regulative control can be set in place to insure service quality management. Informative and motivational control are both indirect mechanisms to interfere with the system, building on self-organizing forces within its ecosystem; both are in support of service quality, motivational control also of service portfolio management. Further research is currently in progress in view of validating the currently mainly epistemic concepts of self-organizing emergent processes on the SAP's e-market platform Agora and on an experimental setting of a Web-based e-Service platform.

References

[AB04] Akkermans H, Baida Z, Gordijn J, Peña N, Altuna A, Laresgoiti I.: Using ontologies to bundle real-world services. IEEE Intelligent Systems (EXPERT) 1 19(4). IEEE Computer Sciety, Washington 2004; pp.57–66.

[BDH08] Bitsaki, M.; Danylevych, O; van den Heuvel, W.J.; Koutras, G; Leymann, F.; Mancioppi, M.; Nikolaou, N.; Papazoglou, M.P.: An architecture for managing the lifecycle of business goals for partners in a service network, Proceedings of the 1st European Conference on Towards a Service-Based Internet. Springer, Heidelberg 2008; pp. 196-207.

[BT05] Berger, T.: Konzeption und Management von Service-Level-Agreements für IT-Dienstleistungen, Dissertation. Technische Universität Darmstadt, Darmstadt 2005.

[BM00] Bovet, D.; Martha, J.: Value Nets: Breaking the Supply Chain to Unlock Hidden Profits. Mercer Consulting, Wiley, New York 2000.

[CG05] Cherbakov, I.; Galambos, G.; Harishankar, R.; Kalyana, S.: Impact of Service Orientation at Business Level. IBM Systems Journal, 44 (4). New York 2005; pp. 653-68.

[DG08] De Kinderen S, Gordijn J.: e3Service – a model-based approach for generating needs-driven e-service bundles in a networked enterprise. In: Proceedings of the 16th European Conference on Information Systems (ECIS 2008). Galway, Ireland 2008.[DW05] De Wolf, T., Holvoet, T.: Emergence versus self-organisation: Different concepts but promising when combined, ESOA 2004, LNCS 3464. Springer, Heidelberg 2005.

[eC10] eCl@ss e.V.: eCl@ss Classification Standard And Its Property Structures (Version 6.2), Cologne 2010; http://www.eClass.de

[FSS10] Fischer, R.; Scholten, U. ; Scholten, S.: A reference architecture for feedback-based control of service ecosystems, Proceeding of the 4th IEEE International Conference on Digital Ecosystems and Technologies DEST 2010. DUBAI 2010.

[FO90] Föllinger, O.: Regelungstechnik. Hüthig-Verlag, Heidelberg 1990.

[IC99] Iansiti, M.; MacCormack, A.,: Developing Products on Internet Time. In: Tapscott, D.: Creating Value in the Network Economy. Harvard Business School Press, Boston 1999.

[PN77] Prigogine, I.; Nicolis, G.Self-Organization in Nonequilibrium Systems: From Dissipative Structures to Order through Fluctuations. Wiley, New York 1977.

[PA04] Pokrovskii, A.: Systems with Hystheresis. Dept. of Applied Mathematics. University College , Cork 2004; http://euclid.ucc.ie/hysteresis/node1.htm.

[SB08] Schaaf, T.; Brenner, M.: On tool support for Service Level Management: From requirements to system specifications. In: Proceedings of the IEEE/IFIP International Workshop on Business-driven IT Management. Salvador 2008; pp. 71-80.

[SSF09] Scholten, S.; Scholten, U., Fischer, R.: Composite Solutions for Consumer-Driven Supply Chains. In: Ronald Bogaschewsky/Michael Eßig/Rainer Lasch/Wolfgang Stölzle (Eds.): Supply Management Research, Advanced Studies in Supply Management, Vol.3. BME, Frankfurt / Main 2009.

[SS10] Scholten, S., Scholten, U.: Innovation Management in On-Demand Businesses. In: Proceedings on the PICMET 2010 Conference on Technology Management for Global Economic Growth. Bangkok 2010.

[VN66] von Neumann, J.: The Theory of Self-Reproducing Automata. In: Burks, A. W. (ed.,): The Theory of Self-Reproducing Automata. University of Illinois Press, Urbana 1966.

[WN48] Wiener, N.: Cybernetics, or Control and Communication in the Animal and the Machine. MIT Press, Cambridge; 1948.

[WO81] Williamson, O. E.: The Modern Corporation. In: Journal of Economic Literature, 19 (4), American Economic Association, Nashville 1981; pp. 1550-51.