# Towards an Automated Gap Analysis for e-Service Portfolios

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***Abstract*—Intermediaries for e-services continuously gain momentum, powered by a materializing Internet of Services. However, quality of service still exhibits considerable shortcomings, as no structured process to enhance consumer satisfaction is available yet. To improve the match of delivered e-service quality and expected service quality on the consumer side, we develop a portfolio optimization process that integrates both, the consumer's as well as the intermediary's perspective. First, we introduce a toolkit for an e-service-oriented gap analysis. Thereupon, we identify monitoring points to measure service quality gaps automatically. A subsequent aggregation of measured data into customized feedback information allows for applying the toolkit to continuously optimize e-service portfolios. Instantiated in the AGORA e-service market, we conclude with a report on our recent implementation results.**

***Keywords: e-services, intermediaries, quality of service, gap analysis, implicit and explicit feedback, portfolio optimization, control theory***

## I. INTRODUCTION

Service intermediaries mediate between service consumers and service providers. The level of intermediation may thereby vary from mere registration services to complex composition services, where service intermediaries actively compose complex services to address continuously evolving consumer needs. Existing mediation platforms such as Salesforce's AppExchange or IBM Smart Market provide good examples of so-called Service Value Networks (SVN) that co-evolve around service intermediaries. Within these fast-changing environments, it is critical to adapt quickly to new service offers or evolving consumer demands. Recent studies reveal that despite efforts to improve service quality in general, Quality of Service (QoS) provided over service platforms still needs to be improved [10].

In contrast to physical goods, which are out of reach to their producers after delivery, composite services allow for agile methods to optimize single services and to improve an intermediary's service portfolio: 1) Service providers can influence services during delivery to adhere to promised levels of service quality [38]. 2) Service bundles or service compositions can be created iteratively and faster than goods [37]. 3) As consumers may cooperate in service delivery, more channels to assess a consumer's satisfaction are available [32]. 4) In particular for e-services, activities that are required for service or portfolio optimization, e.g. collecting and interpreting feedback, can be automated [9]. In related work, we concluded that opportunities arising from these observations are at best partially exploited today [10],[33]. Intermediaries such as Salesforce.com benefit from information collected through monitoring QoS during service delivery. However, information that is retrieved during the service engineering process is only used for monitoring service levels, but relationships between service quality and consumer requirements and expectations are not consistently taken into consideration. In consequence, opportunities to effectively communicate service quality before, during and after service delivery are left unexploited.

Our contribution is three-fold: First, we emphasize the need for a portfolio optimization process that assesses and improves the level of consumer satisfaction in e-service markets in all phases of service engineering. Second, we relate consumer satisfaction parameters to QoS-attributes to ensure measurability of consumer satisfaction. Next, we introduce a continuous service and portfolio optimization process that is based on explicit and implicit feedback information. Last, we describe a prototypical implementation of our portfolio optimization process to validate our approach.

This paper is structured as follows: We first set relevant foundations of services, QoS and feedback control (Section II). Next, we develop an e-service-oriented gap analysis model (Section III.A) and an ontology of service value creation (Section III.B). Thirdly, we create a toolkit for explicit and implicit feedback (Section III.C). Based on these preparatory steps, we design a five-level process to reduce gaps between expected service quality and perceived quality of service, thus to optimize the service portfolio (Section IV). In Section V, we evaluate our approach in SAP's e-service market AGORA. In Section VI, we close with conclusions and an outlook.

## II. FOUNDATIONS

### A. Services and Quality of Service

In the context of service marketplaces, e-services can be described as the outcome of SVNs, which in turn are consumer-driven instances of a business ecosystem [10]. Core parts of a service's description are quality parameters. Service quality is commonly defined as a measure to describe the match of service delivery and consumer expectations [12]. Service delivery typically involves a contractual relationship, which comprises a set of service levels to describe a consumer's demanded service quality.

Depending on the application domain different dimensions of service quality are proposed and applied. For example [25] derive determinants for service quality which are used to describe business-oriented services. Recently, service quality, in particular of Web services has been researched (see e.g. [10],[12],[19],[23]). Here, the monitoring of technical parameters during service delivery (e.g., response time or throughput) has been focused to shed light on the gap between expected and delivered service quality. Quality of service (QoS), in particular the QoS-attributes service reputation and endorsement, is used to facilitate the process of service discovery [20],[36]. [16] analyzed the actual compliance of a service during service delivery with the previously advertised Service Level Agreement (SLA) through explicit feedback (e.g. questionnaires). Furthermore, [7] integrated service quality into the planning of service compositions to address service quality for composed services. Hence, describing and monitoring service quality as well as deliver the promised service quality are considered as fundamental to satisfy service consumers' expectations.

However, all approaches focus on the direct delivery of services by individual service providers. In this work, we consider service delivery through intermediaries. We apply the e3-value ontology [2] to model service quality parameters. Moreover, the use of implicit feedback and consequently collecting and interpreting information that is obtained through monitoring service consumption to assess a consumer's perceived service quality has found only little consideration so far [10],[31]. Therefore, we relate QoS-parameters to both explicit and implicit feedback with the goal to maximize customer satisfaction in service portfolios of a SVN. We conjecture that this can be achieved by minimizing the gap between service quality perceived (rather than measured) and service quality expected (rather than described) by the customer [25]. This requires an extension to previous models to improve service quality with a more detailed gap analysis.

### B. *Feedback-controlled Systems*

Sustainably aligning consumer-perceived and provider-delivered service quality is a challenging goal in perspective of the large and dynamic service portfolios of e-service marketplaces. In a first step, we apply control theory [9] to cope with the dynamics in SVN and the autonomy of service providers. With feedback-controlled systems (see Fig. 1), an actual value (*Y*) of a system is adapted to the level of a set value (*S*). The actual value (*Y*) describes the totality of services offered (service portfolio) and their respective service quality parameters. The set value (*S*) represents the targeted service portfolio and target values for their consumption. Conceptually, this is achieved by feeding the delta between set value and actual value back into the system, where the regulator adjusts the control value (*U*) in a targeted way. Disturbances (*D*) are caused by new providers entering the market or by competing service intermediaries as their actions cannot be controlled, but influence the actual value (*Y*).

The control-theoretical concept helps to guide platform providers to pursue strategic goals in an automated way. However, automation can only be achieved, if an infrastructure for data monitoring, data analysis and comparison of actual situations with target values is in place. Furthermore, a set of control mechanisms to influence autonomous service providers is required that provides a formal basis for feedback control in e-service marketplaces. We discussed existing control mechanisms for feedback-control and developed a software-architecture to implement this control theoretical concept in [9]. Our considerations in this paper on how to monitor existing gaps between expected and perceived quality of e-services build upon this earlier work.

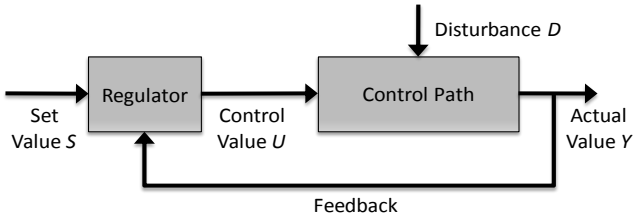



Figure 1. Conceptual model of a feedback-controlled system [10]

## III. LOCATING QUALITY GAPS

### A. *Evaluating Consumer Satisfaction via Gap Analysis*

A model to assess quality of service and service consumer satisfaction is the service quality model [25]. This model describes five major gaps that organizations face in the pursuit of fulfilling service consumer expectations. In traditional approaches, data required to assess each gap was surveyed through structured interviews or questionnaires. In contrast to implicit feedback, which we discuss later, we refer to these approaches as "explicit feedback" [22]. Implicit feedback in contrast deducts relevant information, e.g. by monitoring consumption behavior and deriving performance indicators from e.g. recurring service requests over a given period of time.

For intermediaries the challenge in platform-based service design roots from service composition processes: A service is composed based on consumer choices within the short period of composite service generation and consumption. In differentiation to the original, centrally generated service quality model [25], composite e-services are generated through SVN [10],[37]. We therefore extend the service quality model by complementing the gap analysis with regards to service composition (see highlighted parts of Fig. 2). The gaps depicted in Fig. 2 represent toeholds to monitor and provide feedback that allows improving services and service portfolios as a whole:

*Gap 0* describes the discrepancy between a consumer's expected service quality and the QoS-requirements that are communicated to intermediaries. Gaps of this kind inter alia may root from insufficiently transparent selection mechanisms in the graphical user interface that lead to a misinterpretation of actually selected service features [21].

*Gap 1* represents the discrepancy of how well the communicated service request and the platform's perceptions

of the communicated service request match. Causes that contribute to this gap can be a miscommunication or wrong description of consumer-desired service quality and the platform's perception thereof.

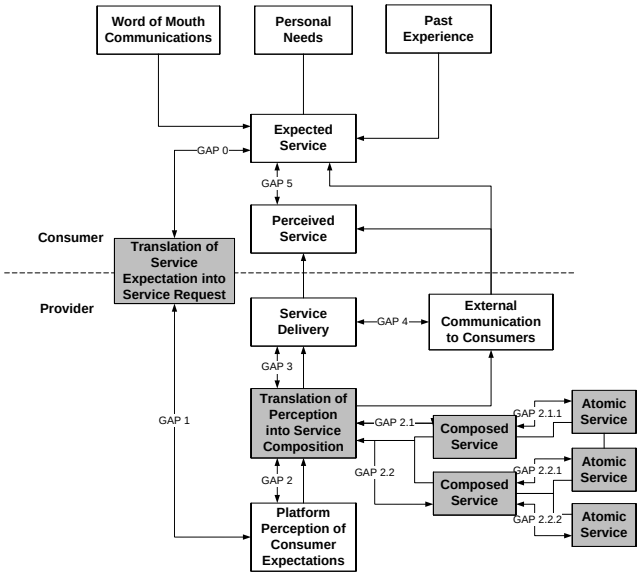



Figure 2. Quality gap model for service value networks, extension of [25].

*Gap 2* results from mismatches between platform expectations on composite service quality and delivery of service components by autonomous service providers. The gaps may originate from multiple sources, including lack of standardization, inadequate commitment for service quality, or resource constraints in the service engineering process [25]. Notice that this gap is influenced by gaps that result from service compositions in SVNs.

*Gap 3* addresses the mismatch between offered and delivered service quality. Technical or organizational issues are sources of this gap that includes unavailability of resources during service delivery. Control mechanisms to motivate adaptations in service delivery when promised service quality levels are not met are introduced in [10].

*Gap 4* focuses on the relationship of service delivery and external communication. As external communication during the service delivery process influences the way consumers experience service quality, external communication plays an important role. This gap may be caused by an ineffective use of forums, blogs, or case studies promising too much or unfounded quality features.

*Gap 5* refers to the gap between the consumer's expected quality of a service and the perceived service quality at service delivery. Ultimately, service providers aim at minimizing this gap. According to [25], Gap 5 is the residual of gaps 1-4. Consequently, minimizing any of the previous gaps improves the match of consumer expectation and perception.

### *B. Modeling Service Quality*

Models are an abstraction of reality, applied to visualize and understand complex constellations and processes. [1] use UML to model the e3-value ontology for service engineering and delivery. Therein, each service element is considered a business activity which involves the exchange of value between actors. A service (bundle) is the result of a configuration, where services are composed to meet customer demands. Outcomes in such transactions are called 'benefits'; inputs describe 'sacrifices' (such as payments). Service inputs and outcomes are subsumed as 'resources'. Introducing resources makes inputs and outputs quantifiable and measurable.

We now refine the e3-value service ontology from the service consumer and the service intermediaries' perspective. In doing so, we link the extended service gap model (see Section III.A) with the e3-value ontology in a way that enables tracing of quality gaps in an automated manner.

From the service consumer perspective (see right part of Fig. 3) vague consumer needs are concretized via wants into a demand, which eventually leads to an expected service property. A service property describes the expectation on the resource "outcome" of a service transaction. These expected resource outcomes materialize as QoS-parameters of a service description.

Intermediaries advertise composite services from a finite number of elementary sub-services offered by service providers (see left part of Fig. 3). Elementary services and service bundles are described comprising functional and quality parameters. During service delivery, services use resources that are described and delivered with a certain level of service quality, denoted as service property.

At the interface between service consumer and service intermediary, we locate the gap between expected and delivered (i.e. observed) service quality. Therefore, we refine the original service quality concept into described, observed, perceived, and expected service quality (see grey boxes in Fig. 3). For the service provider side, service quality as originally proposed in [1] is now reflected as 'described service quality'. On the service consumer side, service quality that is demanded by the consumer is read as 'expected service quality' [2]. The refinement allows us to allocate the gaps of the quality gap model in the e3-value ontology because 1) gap 3 is the gap between described and observed quality, 2) gap 4 is the gap between observed and perceived quality, and 3) gap 5 is the gap between perceived and expected quality.

### *C. Sources of Implicit and Explicit Feedback*

Based on the concept of feedback-based (semi-) automated service optimization, the extend service quality model, and the refined service quality modeling, we now identify sources of required data and ways to collect them.

[31] investigate methods for collecting feedback from consumers explicitly (i.e. using questionnaires) and implicitly (i.e. by observation). The utilization of implicit feedback is valuable for two reasons: (1) all subjects are actual consumers of the product, and (2) feedback is given as a side effect of the service consumption. In analogy to ITILv3, we propose a classification of explicit feedback along a temporal dimension as shown in Table 1, i.e. feedback prior to the service encounter (ex-ante), support and complaint management (during service delivery) and after termination of service delivery (ex-post).

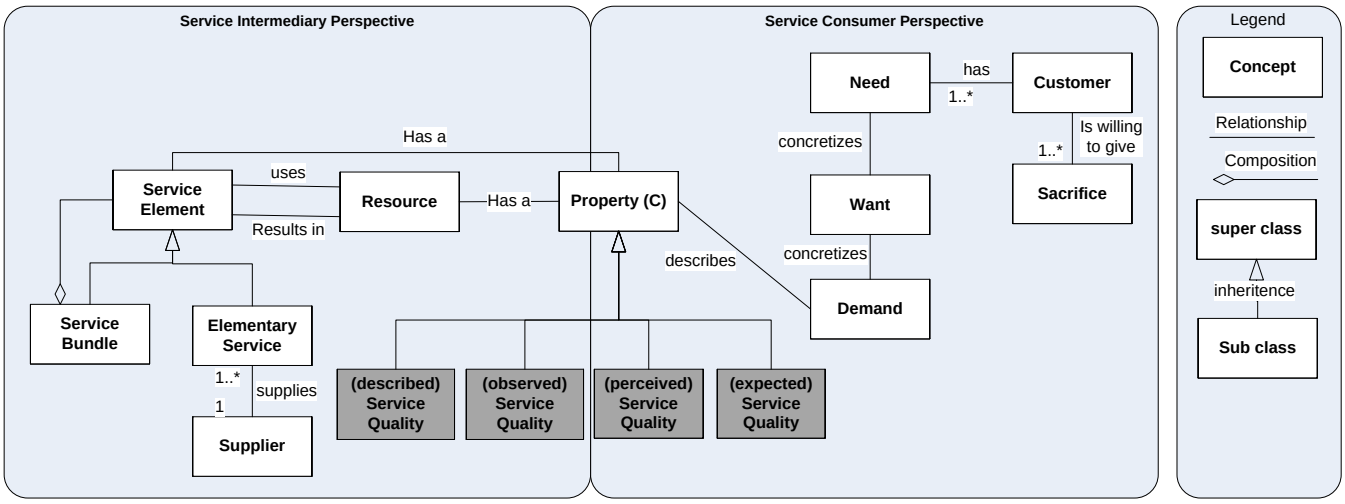



Figure 3. Integrated consumer and service intermediary model (extension of [1]).

TABLE 1. CLASSIFICATION OF EXPLICIT FEEDBACK.

| Category | Feedback Activity | Example |
|---|---|---|
| **Ex-Ante Feedback** | Request new services or service improvements | Customers propose ideas for new offers or improvements of existing ones, e.g. via an idea portal |
| | Market study | Providers ask customers for properties of expected services |
| **Service Support and Complaint Management** | Customer support hotline, call center | Call center in case of issues or request for help |
| | Complaint Email | Email inbox to collect customer feedback initiated by customers |
| **Ex-Post Feedback** | Feedback forms | Questions on satisfaction with supplied service level |
| | Questionnaire | Structured feedback, e.g. SERVQUAL |

*Ex-ante Feedback* is provided before any service encounter or at least the purpose of the feedback does not directly relate to any recent service encounter. Prospective consumers may use this feedback channel to actively propose changes to the service portfolio. In SVNs this may be done via an idea portal, where ideas are submitted for new services or for enhancements of existing services [15]. As another source for collecting feedback, service providers rely on market studies using standardized questionnaires as can be found in SERVQUAL [26] or SERPVAL [18].

*Support and Complaint Management*. Service consumers may request support or report problems during service delivery using channels like online forms or support hotlines. This gives service providers in SVN the opportunity to adjust a service while it is provided, and thus achieving improved consumer satisfaction [34]. Thus, through communicating with the consumer, call centers or IT systems that receive feedback are in a position to instantly interpret the feedback and initiate appropriate adjustments [13]. As an example, they may detect that the source for an erroneous bill is due to an internal error in monitoring service interactions, and thus, the error can be eliminated.

*Ex-Post Feedback.* After the service encounter, consumers may be asked to explicitly state their perception of the delivered service quality. Active methods for collecting feedback rely on (online) questionnaires to collect explicit feedback, e.g. Skype queries consumers in a random selection process on quality of the communication.

Implicit feedback is based on observing the consumer's reaction in the service delivery process. Hence, in the process of offering, searching, and delivering a service as well as after delivering different sources of consumer interactions with service providers or an intermediary are available. Behavioral reactions, for example, can be aggregated to implicit feedback on a user's dissatisfaction [30]. Our interest lies in observing behavioral reactions that serve as indicators for dissatisfaction with the perceived service level, e.g. consumers migrating to other service providers, negative propaganda, or consumer complaints. For example mouth-to-mouth propaganda can be observed in consumer portals [24]. Similar implicit interest indicators are experimentally validated in [8] where reading time and scrolling behavior prove to be good predictors for overall explicit ratings of Web page content. Fox et al. [11] report that certain implicit feedback information, i.e. click-through, time, and exit type of a Web search session, need combination with the order of actions to achieve good predictors of satisfaction of users with search results.

According to [22], three basic types of implicit feedback describe the quality of recommended Web pages: examination, retention, and reference. In the following, we summarize our understanding of implicit feedback types in the context of service marketplaces with regards to this classification (see Table 2).

*Examination*. Whenever consumers select a specific service item in a search result list, preference with respect to other items in the search result is expressed. Similarly, if a consumer spends time on a page to review a service description, reading time may be interpreted as consumer

interest in this service offering. Hence, the consumer's gestures and actions reveal his intent and reactions. In e-commerce, this is reflected by analyzing conversion rates as estimates for future revenue [17].

*Retention*. Activities in this area are performed by prospective service consumers to memorize information for later use, e.g. keeping a wish list of relevant offerings in a service marketplace environment. Services stored in such lists can be interpreted as an indicator for a planned purchase in the near future. Conversely, removing an item from the wish list indicates fading interest in the offering.

*Reference*. A typical approach in community environments is exchanging references to artifacts, e.g. to send a link to a new service offer. Usually these references are sent to raise awareness at the receiver's side in the referenced source. Furthermore, sending the reference can be interpreted as an appraisal of the sender for the referenced item, e.g. as done in social bookmarking sites like del.ico.us. Citations or textual comments may express expectations [24] or valuation of the consumers trust in the provider's competence or benevolence [27].

TABLE 2. TYPES OF IMPLICIT FEEDBACK (BASED ON [22]).

| Category | Observable Behavior | Example |
|---|---|---|
| **Examination** | Selection | Pick one search result |
| | Duration | Reading time for a service description |
| | Repetition | Repeated visit of a service description |
| | Purchase | Purchase of a service |
| **Retention** | Save a reference or save an object<br>- w/wo annotation<br>- w/wo organization | <br><br>- Bookmark a service<br>- Add service to wish list |
| | Print | Print service description for comparison |
| | Delete | Delete a service from the wish list (negative feedback) |
| **Reference** | Object to Object | Send a service description to a friend (forward, reply, post follow up) |
| | Portion to Object | Referral to a service in a textual comment (hypertext link, citation) |
| | Object to Portion | Quote parts of a service description (cut & paste, quotation) |

In summary, all feedback approaches imply that consumers supply data on their preferences and choice without active cooperation (i.e. feedback forms). Monitoring consumer and service interactions allows intermediaries and their complementing service providers to interpret consumers' intentions as a basis for a minimization of the quality gap.

## IV. MINIMIZING THE QUALITY GAP

We now integrate the findings from the previous sections by discussing the required monitoring toeholds that constantly collect feedback information for each service in the platform portfolio. Furthermore, we show how feedback information can be used to assess the size of each of the six quality gaps, introduced earlier. Then, we embed this approach into the introduced concept of control theory to create a consistent, automated and closed control loop for service intermediaries.

### *A. Monitoring Gaps*

As introduced in Section III, explicit feedback and implicit feedback can be applied to gain insights into gaps between consumer expectations, delivered service quality and its perception by the consumer. Table 3 lists methods to collect implicit or explicit feedback by each gap identified in the extended quality gap model. We face the challenge of linking consumer feedback to activities that take place in the service provider's domain, i.e. addressing Gap 2 or Gap 3.

With respect to explicit feedback, three types of feedback exist along the service delivery process (see as discussed in Section III.C). As a complement we propose to use implicit feedback as follows:

*Gap 0*. The results of this market analysis and the resulting service specifications can be validated with lead users to collect explicit feedback, as introduced in [14]. Implicit feedback can be collected by observing discussions in the community (see [24],[35]) or idea portals (see [29]).

*Gap 1*. Besides questionnaires to explicitly collect feedback, a variety of sources for implicit feedback are available, e.g. search query log analysis or click stream analysis (see [8]). In addition, a usability assessment of the search interface is feasible to assess gap 1.

*Gap 2*. As the realization of a service is an activity that is carried out internal to the service provider, explicit feedback cannot be gathered. Nevertheless, a sound service engineering methodology shall lead to better service offers [5] as decisions along the service engineering process are documented consistently [6]. As a source for implicit feedback we rely on methods for service design that involve consumers, e.g. design thinking [4]. Based on early prototypes, prospective consumers are observed in their native working environment to guide the service development early in the service engineering process.

*Gap 3* and *Gap 4* relate to differences between the described or delivered service quality and the perceived quality by the consumer. In all of these instances ratings or interviews after service consumption can be used to capture the differences as experienced by the consumer as explicit feedback. Implicit feedback for Gap 3 can be generated largely by monitoring service delivery [12].

In case of problems – arising during service delivery – the support and complaints management is another valuable source for feedback as it allows responding to problems even during service delivery. The perception of deviations may be

TABLE 3. LINKING QUALITY GAPS TO SOURCES OF FEEDBACK.

| | Gap 0 | Gap 1 | Gap 2 | Gap 3 | Gap 4 | Gap 5 |
|---|---|---|---|---|---|---|
| **Explicit Feedback** | Ex-ante questionnaire | | - | Ex-post questionnaire, support and complaint Management | | Ex-post questionnaire |
| **Implicit Feedback** | Community Mining, Idea Portals | Query log analysis for search, click stream analysis | Design thinking | Monitoring | Community mining | - |

measured using explicit feedback or implicitly when consumers cancel the service delivery. Gap 4 relates to the communication of delivered service quality; community mining [24] may be used to analyze discussions and reports of consumers in community portals.

In a first step, we suggest to create reports for each of the cells in Table 3 for semi-automatic analysis. We would like to point out that both reports and analysis are generated on a continuous basis, and thus allow for a continuous improvement of the service portfolio. Proposals to adapt the service portfolio should be integrated into the service lifecycle [33] to minimize the residual Gap 5.

### B. *Analysis and Adaptation of Service Portfolios*

The gap analysis introduced in the previous section refers to quality properties of individual services within the service portfolio. Proceeding from there, Fig. 4 describes the process of how to instrument those findings to improve deployed services respectively the whole service portfolio.

Based on the analyzed gaps, the service provider receives suggestions from the intermediary on required service optimization. Examples are the modification of a service [33], an intensification of communication of service offers (addressing gap 4) or even undeployment of a service in case of poor ratings or few orders.

Service providers reason and act in a pure service view. In contrast to that, intermediaries act from a portfolio and service view. Intermediaries may provide recommendations for changes on the service level to each individual service provider. In a filter function, intermediaries are capable of restricting access to service deployment and if necessary remove a service from the portfolio.

Adaptation of the service portfolio means modifying, excluding or adding services based on the analysis of the service portfolio. As feedback in our system is collected iteratively, it is possible to apply a 'modify-and-observe strategy', as it is successfully applied in e-service marketplaces like Amazon.

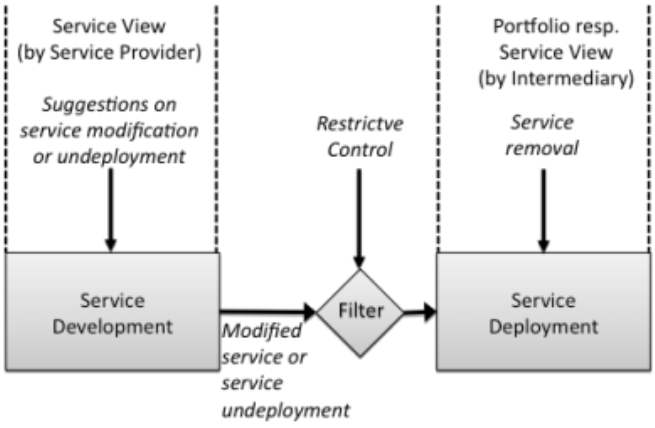



Figure 4. Points of intervention to adapt service portfolios.

## V. INSTANTIATION

In this section, we outline a first instantiation of our approach in AGORA, a platform pilot for an e-service marketplace, developed at SAP Research[1].

AGORA implements the process of finding, configuring and ordering services as well as monitoring the progress of their delivery and post-delivery activities like payment, rating and support and complaint management. The services offered in AGORA complement products offered by SAP, e.g. data migration services or report adaptation. Services may be offered by SAP, but also by its partners. As the service runtime is independent of this service brokerage platform, the actual delivery of the e-services is not in the scope of this platform. AGORA focuses on mediation. Nevertheless, the progress of service delivery can be monitored using status indicators.

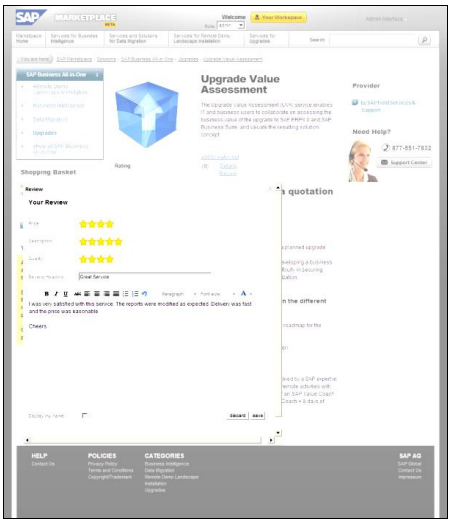
AGORA is a consumer-facing system to find, configure and order e-services, thus it is the prime system to collect feedback – implicit as well as explicit. In the following, we outline how monitoring of explicit and implicit feedback was implemented in this system (see Fig. 5). We also discuss how this information is used to close the control loop using the feedback information.

*Explicit feedback* is collected on the level of services and service providers. Only users who ordered services are eligible to rate services as we want to rate the quality of service encounters (see Fig. 5b). Marketplace providers globally configure a set of rating attributes using a 5-star rating system, which represent general QoS-attributes in AGORA, e.g. timely delivery or QoS-description. Ratings are aggregated to an overall rating which is usually not assessed directly. Furthermore, consumers can enter feedback in free text comments. Service providers are able to review the ratings in reports to assess popular offerings (see Fig. 5c).

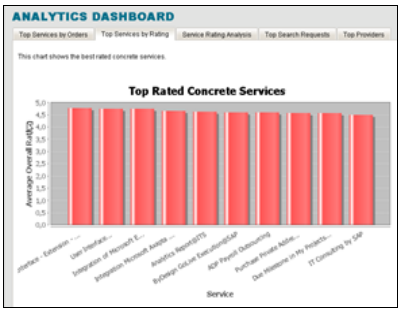
*Implicit Feedback* is currently collected from obfuscated logs. Besides the technical log of the Web server, an important source of data is the business log, which is used to trace business-level actions like page visit, adding services to the shopping cart, or a service purchase. As we associate these events to sessions, we are able to analyze quantities of single page views as a measurement of consumer interest (see [8]). Furthermore, we are able to analyze click-through times and exit events to predict consumer satisfaction, as reported in [11]. Thus, AGORA supports the monitoring of observable behavior in the category "examination" mentioned in Table 2. As of now, repeated visits to a page are only detected within one browser session. As for retention, AGORA implements a watch list (see Fig. 5d), where prospects can keep references to service descriptions for later use. Thus monitoring of creating and deleting object references is implemented. Printing and bookmarking are functions accomplished via the Web browser. Therefore, we do not have access to this information. Implicit feedback of type 'reference' is difficult to assess as hyperlinks to pages

[1] Further information on the pilot system is available at http://www.internet-of-services.com

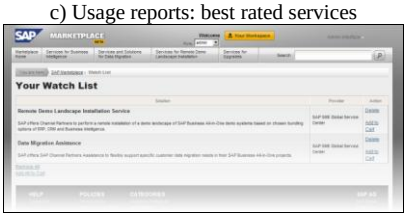

a) Personalized AGORA entry page




b) Rating dialog




c) Usage reports: best rated services




d) Watch list

Figure 5. Sources for and usage of feedback in AGORA.

can easily be copied and forwarded. This cannot be detected by our service-based application. Analyzing referrer logs, however, allows detecting common sources that send visitors to AGORA. As a future step, individualized links will be used as an approach to track different origins of reference.

Enforcement (restrictive control, service removal) as described in Fig. 4 is implemented in multiple ways: General access to the marketplace requires authentication. Thus providing user accounts is regulated by AGORA as the intermediary. Providers can enter, modify, or undeploy services as they wish. However, changes are performed in a staging area and versioned. In consequence, the intermediary has full control on changes of the service portfolio including the removal of service offers.

So far, gap analysis and adaptation of the services and service portfolio is manually performed based on the information provided in analytic reports (see Fig. 5c). Even though manually accomplished, we are able to measure a modification of service quality in test loops based on implicit and explicit feedback that is provided to service providers. The integration of tools for a more automated process of service portfolio optimization is currently under development allowing future work to create new optimization and innovation scenarios.

## VI. Conclusion and Outlook

In this paper, we introduced a process that supports intermediaries in optimizing their service portfolio. We applied concepts of control theory to increase consumer satisfaction through improved quality of service. Moreover, we applied and extended the quality gap model into the domain of e-services by adding a sixth gap that addresses electronic communication channels between service consumers and the intermediary.

In order to assess consumer satisfaction, we require precise measurements of quality gaps. To reach this goal, explicit feedback is applied in state of the art. We complement to the state of the art by implementing implicit feedback, which is based on observing consumer behavior. In doing so, quality of service can be continuously monitored and thereafter optimized, leading to an optimization of the e-service portfolio as a whole. Based on the received feedback information, service providers are inclined to improve their service offers. To evaluate our optimization process, we applied our concept in a case study with SAP by piloting the AGORA e-service marketplace.

In pursuit of higher levels of automation to increase reactivity of intermediation, our future work will aim at improved software architectures and related data mining algorithms for the monitoring of distributed value generation. Moreover, formalizing the control mechanisms that allow service intermediaries to control service ecosystems in a proactive way will be considered in more depth.

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