Asia Pacific Journal of Information Systems
Vol. 30 No. 1 (March 2020), 94-119

ISSN 2288-5404 (Print) / ISSN 2288-6818 (Online)
https://doi.org/10.14329/apjis.2020.30.1.94

Key Quality of Service Attributes of Digital Platforms

Nandakishore K N[a,*], V Sridhar[b], T K Srikanth[c]

[a] *Researcher, International Institute of Information Technology Bangalore, India*
[b] *Professor, International Institute of Information Technology Bangalore, India*
[c] *Professor, International Institute of Information Technology Bangalore, India*

A B S T R A C T

Digital platforms characterized by network effects enable provisioning of various types of services and provide a mechanism for linking producers and consumers. Identifying the key Quality of Service attributes of such platforms is vital for their continued success and growth. In this paper, a set of quality attributes for platforms is first extracted from different extant quality models. Then actual user feedback data from three platform providers are analysed and mapped against the set of quality attributes to determine the key attributes that are relevant. These findings are corroborated with qualitative data from interviews of different stakeholders. The results show that service quality characteristics are important to the success of platforms. Functional characteristics of platforms assume importance where the digital contributions of the platform is higher. Apart from these, 'fitness for use' as a major determinant of quality is also important in digital platforms.

Keywords: Digital Platforms, Quality Attributes, Education Technology Platforms, Healthcare Platforms

Ⅰ. Introduction

A platform is "a business based on enabling value-creating interactions between external producers and consumers" (Parker et al., 2016, p. 5). Platforms which use digital infrastructure as a base for the interaction, either wholly or partly ('digital platforms') are considered in this paper.[1)] Such platforms are disrupting businesses like never before (Hagiu and Rothman, 2016, p. 1), and are set for tremendous growth (Changing Gears, 2017; Moazed, 2018; Online Education Market in India, 2016). Platforms have the following primary stakeholders: (i) a platform provider, who is the owner of the platform; (ii) the end-user, who is the primary consumer of the interactions on the platform; and (iii) one or more service providers who provide services to end users.[2)]

Digital platforms are characterized by both direct and cross-side network effects (Gawer and Cusumano, 2014). Researchers have argued that platform quality, and associated consumer expectations, also play a

*Corresponding Author. E-mail: nandakishore.kanakatte@iiitb.org

crucial role in growth and sustainability of platforms (Zhu and Iansiti, 2017). Tellis et al., state that quality in certain instances are more important than network effects for the success of platforms (Tellis et al., 2009, p. 147). Hence it is important to assess the significant factors which affect the Quality of Service (QoS) of these platforms as perceived by its users (Ruutu et al., 2017, p. 123). In this paper, the term QoS is used in the context of capturing the quality of the provisions of the platform in its entirety.

The existing literature on platforms has mainly focused on quality assurance in software ecosystems (Axelsson and Skoglund, 2016); value creation and distribution in platforms (Haile and Altmann, 2016); design and configuration of digital payment platforms (Kazan and Damsgaard, 2016) and evaluation of e-learning platforms (Ouadoud et al., 2016).

Quality has been defined in many ways, most notably by (Crosby, 1980; Juran and Godfrey, 2000), however the ISO definition of quality as "entirety of features and characteristics ⋯ of a product or service ⋯ that bear on its ability to satisfy stated or implied needs" (ISO 5127:2001), is the definition taken for this paper. Recent literature on quality in platforms relate to quality in software architecture (Kaur and Singh, 2015; França and Soares, 2015), quality of Decision Support Systems (Iqbal and Babar, 2016), and quality in crowdsourced systems (Allahbakhsh et al., 2013; Kulkarni et al., 2012). However, study on quality attributes that impact customer satisfaction in digital platforms in scarce. Specifically, in this paper it is attempted to answer the following research question:

What are the key quality attributes that are important in digital platforms and their impact on customer satisfaction?

In this study, we specifically focus on the study of platforms in the area of education (a.k.a. EdTech) and healthcare (HealthTech) sectors. In EdTech platforms, the platform providers are typically companies or universities who offer digital courses or online teaching services. End-users are individuals or groups who consume these offerings. Service providers may be personnel who provide the educational content / material in any form, faculty or other personnel who actually deliver the content on the platform, or IT companies who may provide some infrastructure components to the platform provider for the educational exchange.

In HealthTech, platform providers may be again companies or individuals who sponsor the platform as a business. Users are individuals or groups who consume the platform provisions. Service providers may be doctors, pharmacists or other medical professionals, or may provide digital infrastructure to the platform provider.

This paper is organized as follows: The next section examines platform and associated quality attributes. This is followed by the research methodology, data collection and the results. The final section contains research conclusions, limitations and scope for further work.

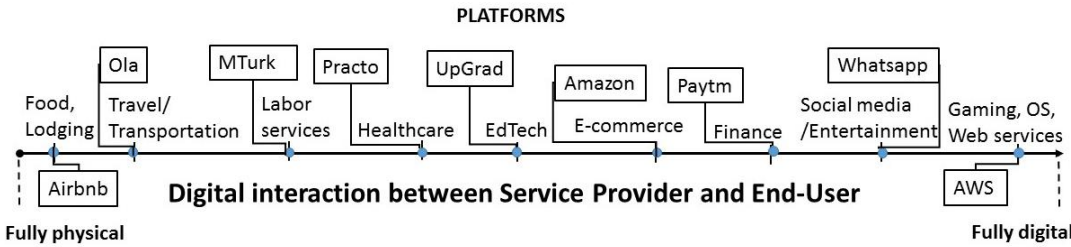
1) This paper is largely drawn from (Nandakishore K N, 2018).
2) Some literature (for example, Kim and Kim, 2016), describe, in addition to the platform provider, a 'platform sponsor' who may be responsible for decision-making regarding platform technology or other aspects. In this paper, all such entities are ignored and only the 'platform provider' is considered, as a platform representative distinct from demand-side 'end-users' and supply-side 'service providers'. Also note that the platform provider may also be a service provider (for example, in an initial phase of operation) but technically not the reverse.

Ⅱ. Platform and Quality Attributes

2.1. Categories of Platforms

There are varying degrees of digitization in platforms for communication and provisioning of services, ranging from minimal to full, and can be arranged on a continuum as shown in <Figure 1>.

An indicative example of a platform along with the industry vertical is shown in the figure. At one end are the largely 'physical' businesses where the digital interaction is less. For example, in the hospitality-related businesses, booking can be through an online platform but the user moves through or occupies physical space with material elements in it, and hence the service quality or ambience then comes into play. At the other extreme are activities like virtual gaming (where the user is in contact solely with the digital platform) or essentially computer elements like Operating Systems or Web services ('platforms providing platforms') whose users consume digital elements and physical interaction with service providers is minimal.



<Figure 1> Platform Continuum

Along this continuum, the different types of industry verticals can be arranged[3]:

- In travel/transportation, applications play a key role in accessing the concerned physical element (like a taxi or an airplane), but subsequently, the service quality too is important.
- Human workers carry out jobs but work can be allotted or done online.
- Healthcare is mostly about doctors, nurses and pharmacists providing medical services. The initial contact may be online or offline, and likewise, though the service is mostly offline, it is possible to have digital elements. There can also be other types of digital healthcare-related platforms.
- The education technology (EdTech) providers are another example where there may be a digital interface providing content or optionally instructors guiding students through course material or giving lectures.
- E-commerce chiefly involves shopping online and receiving the product or service at one's doorstep.
- Financial transactions are done online, triggered or set up by humans.
- Social media and entertainment involves social connections between humans digitally and consumption of digital entertainment content.

It is also of note that the position of a platform on the continuum is not fixed; it can vary depending on the degree of 'physical' vs 'digital' components

3) It must be emphasized that the aim of this paper is not to accurately locate the various platforms on this continuum. This construct is used to bring out the crucial differences in the *types* of platforms.

in that specific case. For example, the Healthcare vertical is positioned towards the left on the continuum since the vertical typically involves healthcare providers treating patients physically, but a platform which connects doctors and hospitals for management of electronic health records is likely to lie further along (to the right side of) the continuum due to the digital nature of the activities involved. In this study, we analyze a sample of two platforms in HealthTech and EdTech that are positioned almost at the middle of the above scale.

2.2. Quality Model and Attributes

Quality models for digital platforms are inherently not much different from software quality models and can be seen to have the same characteristics. ISO offers several quality models, out of which ISO 25010:2011 is selected as a base model in this paper for evolving the quality attributes as it has evolved from various software models and is an international standard. It has been used as a starting model in various research papers and dissertations (for example, Hasan and Al-Sarayreh, 2015; Parnanen, 2016).

ISO 25010:2011 contains a product quality model and a "quality in use" model (ISO/IEC 25010:2011). The product quality model consists of eight groupings of characteristics with associated sub-characteristics, giving a total of 39 attributes. Most of these attributes describe the software technical aspects, however the 'Functional Suitability' and 'Usability' groups deal with functional aspects and product attributes which may be termed as being more 'subjective' in nature.

The "Quality in use" model has 11 attributes and evaluates the product from the perspective of the user while using the product. The characteristics in this model are more subjective in nature. For example, 'Trust' or 'Comfort' are attributes which are not directly measurable and may vary in degree of impact from person to person. Though some of the attributes like 'Completeness' and 'Efficiency' have the same terminology as those in product quality, the definitions and interpretations of the attributes are different in the two models under ISO 25010:2011.

It should be mentioned that several of the attributes appear to be similar in their description, but a closer look reveals subtle nuances. For example, the attributes of Functional Suitability and Functional Appropriateness appear to not be very different. But where Functional Suitability concerns the provision (or otherwise) of capabilities to meet users' needs, Functional Appropriateness evaluates the degree to which the provided capabilities actually meet those needs. Similarly, Learnability assesses the degree to which the product or system's learning goals can be met (in other words, ease of learning to use the system), whereas Operability is a measure of the product or system's attributes which make it easy to operate and control.

Yet another category of attributes which need to be considered in the quality model for digital platforms is service quality. Services differ from goods in terms of how they are produced, consumed and evaluated (Zeithaml et al., 1990). Ten general dimensions of service quality have been proposed (ibid., pp. 21-22).

A few other attributes which influence a user's satisfaction with the product or service, are considered in this paper. First of these is Affordability as users seek value for money and hence this influences customer satisfaction. 'Capability' and 'Conformance' are two subjective system aspects which are not directly addressed in the work of Zeithaml et al. (1990). Capability is a measure of an entity's ability to achieve its objectives, especially from an overall mission perspective. Conformance is basically a quasi-sub-

jective confirmation that a product or service has met some rule or best practice. The attributes of Dependability, Robustness, Safety and Conciseness are not included, or have a slightly different nuance to their comparable equivalents, in ISO 25010: 2011 and the work of Zeithaml et al. (1990). Nevertheless, these attributes might be significant; for example, Kang et al. (2015) found that interpersonal trust significantly affected learning satisfaction in online communities. Hence these attributes are included in this paper separately.

Ⅲ. Methodology and Data collection

3.1. The Quality Attribute Set

Grouping together the characteristics from the quality models as explained in the previous section yields a set of 64 attributes in total[4]. A summary of the 64 attributes is given in <Table 1> and shown group-wise in <Figure 2>. The definitions of these 64 attributes are given in <Appendix A>.

<Table 1> Summary of Attributes

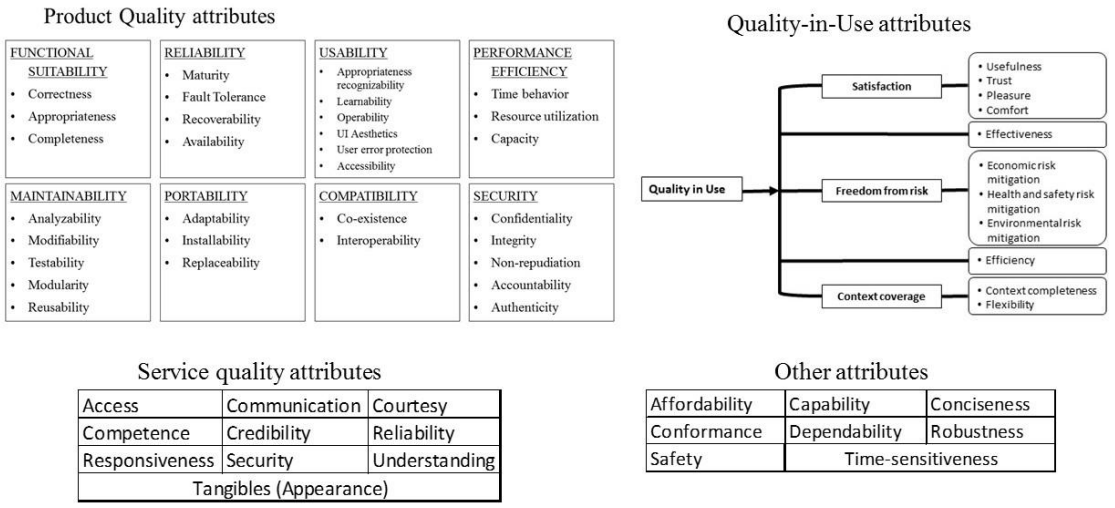
Source	Aspect	No. of attributes	Final no. for consideration
IS0 25010:2011 model	Product Quality	39	35
IS0 25010:2011 model	Quality in Use	11	11
Zeithaml et al. (1990)	Service Quality	10	10
Others	Cost, time and others	8	8
		Total	64

The conceptual basis of synthesizing from the different models stems from the nature of stakeholder interaction on platforms. Users and service providers interact in value-creating ways, hence the service quality characteristics also need to be considered. Examples of such 'customization' of a quality model exist, see for instance (Behkamal et al., 2009). Also, other parameters like price, time pressure and conformance influence user decisions in selecting and using a platform (Moon et al., 2015; Suri and Monroe, 2003).

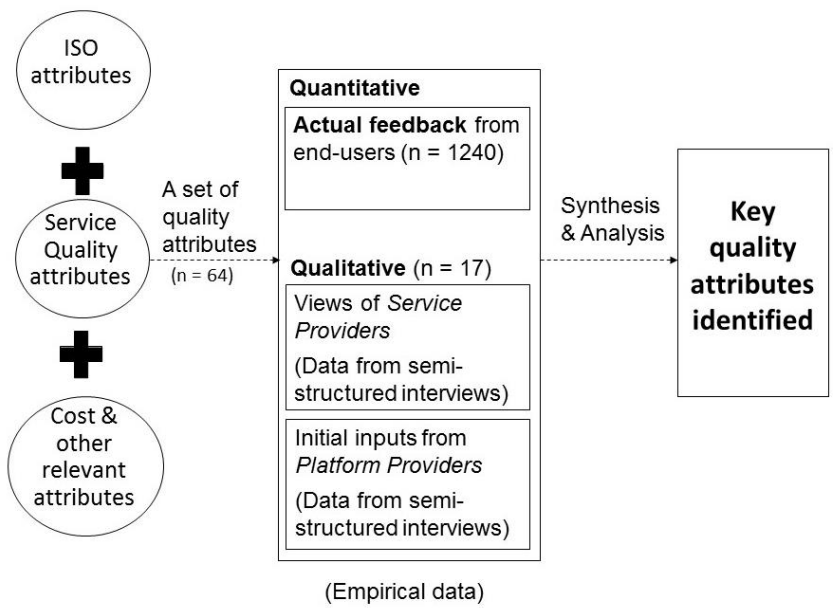
3.2. Analysis and Validation

Actual feedback data from end-users of digital platforms were mapped to the set of 64 quality attributes so defined, and analyzed along with data from service providers and platform providers, to extract the key quality attributes. Implications for platform providers were also distilled from the findings. An intercoder reliability exercise was conducted to avoid any bias affecting the findings. A diagrammatic representation of the research methodology is given in <Figure 3>.

4) Attributes 'Performance Efficiency', 'Security' and 'Reliability' mentioned in the ISO 25010:2011 Product Quality model are mentioned in the "Quality-in-use" and Service Quality models as well and hence are counted only once.
Also, one attribute which has been 'customised' for this paper is 'Time-sensitiveness'. ISO 25010:2011 lists the attribute of 'Time behaviour' but this definition, true to the overall intent of the 25010 standard to define software product quality, connotes machine performance. However in service quality, there are often instances where it is necessary to do things not at a *fast* pace, but at the *required* pace. For instance, if a teacher is explaining new concepts to a bunch of students, it may be necessary for the teacher, on occasion, to slow the pace down so that a particular concept can be fully understood.
Hence in this paper the definition of time behaviour is broadened to allude to all such cases where the actor (human or machine, as the case may be) meets the temporal requirement in that particular instance. To distinguish it from the existing term, the term 'time-sensitiveness' is used instead of 'Time behaviour' in the rest of this paper, and has been placed in the 'Others' category in <Table 1> and <Figure 2>.



<Figure 2> Attributes by Group



<Figure 3> Research Methodology

3.3. User Feedback Data Collection

Empirical data was obtained from three platforms - two education technology (EdTech) providers (UpGrad and Coursera) and one Healthcare access provider (Practo). EdTech and Healthcare are two platform verticals which lie roughly in the middle of the platform continuum explained earlier and hence they were good choices to assess the quality of platforms, by virtue of not being extreme cases,

<Table 2> Details of UpGrad Data

Batch 1(Cohort1)

Total number of feedback received	Total usable records(after removing blank or junk entries)	Breakup of the 4125 records as per feedback rating given by user				
		Rating of 1	Rating of 2	Rating of 3	Rating of 4	Rating of 5
28133	4125	287	369	1066	1234	1219
No. selected for sampling		72	62	60	56	60

=310 total

Batch 2(Cohort2)

Total number of feedback received	Total usable records(after removing blank or junk entries)	Breakup of the 3891 records as per feedback rating given by user				
		Rating of 1	Rating of 2	Rating of 3	Rating of 4	Rating of 5
23451	3891	121	185	1201	1202	1182
No. selected for sampling		56	62	59	61	62

=300 total

hence allowing an examination of both physical and digital aspects of the platforms. Also digital platforms on these two verticals are newly emerging (unlike, say, e-commerce which has had a considerable history of platform activity in India) and it was felt researching these verticals is of current interest. The two EdTech platforms are slightly different from each other in terms of the niche market they address and hence offer some variety (UpGrad mainly offers online courses with certification to selected students while Coursera is a one-to-many course provider).

Two datasets (from two different Cohorts[5]) containing user feedback on various courses and modules were obtained from UpGrad. These datasets contained user rating for each course/module on a scale of 1 to 5, as well as feedback in text form. Systematic stratified sampling was used to generate the final sample data (310 and 300 feedback records from Cohort 1 and Cohort 2 respectively) for analysis (see <Table 2>). The details of sample size calculations and sampling techniques used are mentioned in Sec 3.4.

For Coursera, user feedback for its various courses is available on its website and this data was used for analysis through a process of cluster sampling. Only courses taught in English with subtitles in English were picked for analysis due to language constraints. Random courses from random pages were selected, the only criteria being that the course have entries in the 'Ratings and Reviews' field. As the data was being captured manually, courses were selected which had a moderate number of reviews (10 to 50) for ease of capture. At least one course was picked from each of the ten course areas listed (Business, Data science, Computer science, Physical science and engg, Social sciences, Personal Development,

5) A 'Cohort' refers to a batch of students starting a course together

<Table 3> Details of Coursera Data

Details of chosen coures for feedback data		
S1 No	Coures area	Final nos (after removing invalid entries)
1	Computer secience	24
2	Physical science and engineering	25
3	Personal developmnet	29
4	Life Sciences	29
5	Language Learning	10
6	Math and Logic	38
7	Business	20
8	Data Science	9
9	Social Science	40
10	Computer Science	39
11	Arts and Humanities	41
	total	**304**

Life Sciences, Arts and Humanities, Language Learning, Math and Logic) so as to provide a dataset having maximum variation in terms of courses and without being biased towards any particular domain.

The data was retrieved on 8-Sep-2017 from the Coursera website (https://www.coursera.org). A total of 304 feedback was captured for analysis as summarized in <Table 3> and explained further in Sec 3.4.

For Practo, user (patient) feedback is available on its website (https://www.practo.com) and this data was used for analysis through a process of cluster sampling. Names of doctors by specialty were picked at random from the website, the only criteria being that the doctors have entries under both 'Overall rating' and 'Feedback received' fields in the portal. As the data was being captured manually, the names picked were initially restricted to a moderate number (< 50) of textual feedback for ease of data capture. As many specialties and range of doctor's ratings as possible was picked so as to provide a dataset having maximum variation in terms of ratings and medical domains.

<Table 4> Details of Practo Data

Speciality	No. of doctors	No. of feedback received
Andrologist	1	2
Ayurveda	1	5
Cardiologist /Cardiothoracic and Vascular Surgeon	2	87
Dentist /Dental surgeon	3	12
Dermatologist	1	7
Endocrinologist	2	20
ENT /Otorhinolaryngologist	1	3
Gastroenterologist	1	9
General Physician	3	62
Geriatric Physiotherapist /Psychiatrist	2	7
Gynecologist	2	7
Internal Medicine	1	21
Neurosurgeon /Spine surgeon	1	4
Opthalmologist /Eye surgeon	1	5
Orthopedist	2	17
Pediatrician	5	30
Physiotheraist	1	12
Plastic surgeon	1	4
Pulmonologist	1	4
Urologist	1	8
total		**326**

The data was retrieved over a period of several days between March and October 2017. A total of 326 feedback was captured for analysis as summarized in <Table 4> and explained further in Sec 3.4.

3.4. Details of Sample Size Calculations and Sampling Technique

For analysis, a minimum sample size of 300 was

considered suitable based on a 6% sampling error tolerance on a 50-50 chance of the sample having atleast one of the key attributes identified earlier (from Fowler's Tables as cited in Creswell (2002, <Table B.1>, <Appendix B>). The aforementioned source gives values for a 95% confidence interval. Hence, the data sample size was 310 and 300 (for each UpGrad cohort respectively), 304 for Coursera and 326 for Practo.

On a first examination of the UpGrad dataset, it was found that the textual feedback in the cases where the ratings were 1 or 2 generally had more details and hence 'disproportionate sampling' (Gray et al., 2007, p. 109) has been used so as to try and capture as many quality attributes as possible. Further, since the goal was only to extract the quality attributes and not estimate a population characteristic, no weightage correction factor has been used.

3.5. Coding and Mapping Attributes

For each of the four datasets, a quantitative coding process as mentioned in (Emerson et al., 1995) was used, wherein key words in the textual feedback were identified by 'data simplification and reduction' followed by 'interpretation' (Coffey and Atkinson, 1996). Then these keywords were mapped to one or more of the 64 identified attributes (see Sec 3.1) for each individual feedback. Then, to these mapped attributes, ratings were assigned on a Likert scale of 1 to 5 (1 = very dissatisfied, 5 = very satisfied) based on the emotions emergent in the user's text feedback. For example, if the text feedback contained very negative indictment of any aspect, the assigned rating would be 1, versus a less strongly expressed dissatisfaction, which would be assigned a rating of 2. A similar gradation of positive feedback was the difference between ratings of 4 and 5. Moderate satisfaction or 'ok' statements would result in a rating of 3. A single feedback was thus mapped to one or more attributes, with separate ratings (which could be the same or different, depending on the emotion for that attribute) in case of multiple attributes. Coding examples are given in <Appendix B>.

A correlation analysis of the rating given by the user, with the assigned rating(s) for the mapped attribute(s) was done. The degree of association between user satisfaction (as represented by the user-given rating), and each quality attribute was measured. Overall alpha level was set at 0.05 (95% confidence level).

3.6. Data from Platform and Service Providers

A total of seventeen interviews (N = 17) were conducted with service providers (teachers and doctors) and platform providers, spanning 5 EdTech and 2 Healthcare platforms. The aim of these interviews was to firstly, elicit views of platform providers during the initial stages of planning the research, and secondly, to gauge the views of service providers and understand the roles played by them in the platform scenario. These interviewees were chosen by a combination of convenience and snowball sampling. Thirteen interviews were conducted face-to-face at the office of the respondent and four were telephonic interviews. The interviews were conducted in brief periods in the months of Feb-2017, June-2017, and Nov-2017 to March-2018. The duration of each of the interviews varied mostly between 20 to 30 minutes. All but four of the respondents consented to have the interviews recorded for later transcription and analysis.

The interviews mostly consisted of a set of prepared questions dealing with the respondent's experience of dealing with the concerned digital platform, only

occasionally veering away to pursue a certain line of thought or insight arising during the conversation. For the interviews which were recorded, transcripts of the conversations were made for easier analysis. These transcripts were then scrutinized multiple times to gauge patterns or highlight individual experiences, and studied in conjunction with the quantitative results to draw meaningful conclusions. The set of questions are given in <Appendix C>.

Ⅳ. Data analysis and Results

4.1. Quantitative Analysis Results

The results of the correlation analysis are as shown in the tables <Table 5> to <Table 8> below. Only the statistically significant attributes are shown here and listed alphabetically. The correlation coefficient has been rounded to three decimal places. The third column, N, is the number of user feedback having

<Table 5> UpGrad Results – Cohort 1

Attribute	Correlation Coefficient	*N*	Proportionality Index
Appropriateness recognizability	0.661	82	0.204
Competence	0.700	30	0.075
Functional appropriateness	0.549	136	0.339
Functional suitability	0.493	56	0.140
Time-sensitiveness	0.548	28	0.070
Usability	0.753	9	0.022

<Table 6> UpGrad Results - Cohort 2

Attribute	Correlation Coefficient	*N*	Proportionality Index
Appropriateness recognizability	0.710	50	0.147
Competence	0.882	19	0.056
Functional appropriateness	0.486	152	0.446
Functional suitability	0.372	53	0.155
Time-sensitiveness	0.552	15	0.044

<Table 7> Coursera Results

Attribute	Correlation Coefficient	*N*	Proportionality Index
Appropriateness recognizability	0.818	143	0.346
Competence	0.942	26	0.063
Functional appropriateness	0.732	9	0.022
Functional suitability	0.710	145	0.351
Time-sensitiveness	0.811	21	0.051
Usability	0.830	17	0.041

<Table 8> Practo Results

Attribute	Correlation Coefficient	*N*	Proportionality Index
Access	0.609	27	0.030
Appropriateness recognizability	0.328	146	0.164
Communication	0.565	168	0.189
Competence	0.293	120	0.135
Courtesy	0.665	133	0.150
Credibility	0.631	29	0.033
Responsiveness	0.637	30	0..034
Time-sensitiveness	0.564	33	0.037

the concerned attribute. The Proportionality Index is the proportion in which that attribute occurs in the entire list of attributes and has also been rounded to three decimal places.

Hence the key quality attributes have been filtered in a two-step process:

1) The 95% confidence level set ensures that the correlation coefficient of the attributes in the sample is representative of the correlation coefficient of the population attributes.

2) Disregarding the statistically significant attributes which figure in lesser number of data records (i.e., a proportionality index of 0.02 or lesser) ensures that any chance occurrence of the attribute rating matching the user-given rating, is not considered.

4.1.1. Results for UpGrad

The most significant attribute is Competence, with a coefficient of 0.700 and 0.882 from the two cohort files respectively, which implies possessing the required skills and knowledge highly influences the quality of the platform. Appropriateness recognizability comes next, with values of 0.661 and 0.710, which denotes that users can and do discern whether the particular course in its entirety meets their needs. Functional appropriateness and Functional suitability are the next significant sub-characteristics, which reflect the ability of the product or system to meet the user's needs and facilitate accomplishment of objectives from a functional standpoint. Usability, which is the degree to which the product or system can be used satisfactorily in a specified context of use, is also significant (in Cohort 1) even though it figures in a lesser number of records.

4.1.2. Results for Coursera

Here again the most significant attribute is Competence. Appropriateness recognizability, Functional suitability, Functional appropriateness and Usability are also significant, similar to the UpGrad results.

4.1.3. Results for Practo

The results for the healthcare vertical Practo markedly differ from the results for the EdTech providers. Here the most significant attributes are the service quality characteristics such as Courtesy, Responsiveness, Credibility, Access and Communication, all with coefficient values between 0.665 and 0.565. Appropriateness recognizability and Competence are significant too.

4.1.4. Inter-coder Reliability

To avoid a confirmation bias affecting the findings, a mapping exercise was conducted involving three coders – two co-authors of this paper, and a doctoral research student who was not associated with this paper in any manner - and ascertain the intercoder reliability. 10% of the full sample size was picked randomly from the available datasets. The coders had moderate agreement (Krippendorff's alpha = 0.601).

4.2. Qualitative Analysis Results

As mentioned in an earlier section, a total of seventeen interviews were conducted with platform and service providers from the two platform verticals. The findings from these interviews are presented by vertical.

4.2.1. Results for EdTech vertical

1) Competence of the Service Provider

One of the EdTech service providers [EP4], when asked about the teacher-student arrangement on his platform, responded:

"… It is one-to-one, and the teacher tweaks the teaching based on what the student wants. It is completely customized, as the requirements / capabilities of students are different for each person. … The differentiating factor is customization of teaching."

Another service provider [EP5] who is on another EdTech platform, when asked about what is needed to ensure quality of content, talked about different types of students:

"[We need] some sort of agreement on what is the model of student we are assuming, what is the model of industry need, so if we have a common ground [with the platform provider], we can develop material and take it forward".

The above snippets throw insights on two aspects – Firstly, they give a glimpse of the different backgrounds and abilities of the students who take courses on these EdTech platforms. These platforms, by virtue of being easy to access from any part of the country or even the globe, brings students from different socio-economic conditions, cultural backgrounds and varied upbringings onto a platform to receive coaching on a certain subject. And, if a platform's Unique Selling Proposition (USP) is to replicate individual learning scenarios (mostly without the benefit of face-to-face interaction), it requires a certain experience and ability to successfully ensure that happens. This is where the competence of the instructor is put to the test – an attribute which is also indicated in the quantitative results.

2) Appropriateness recognizability

Secondly, it provides a confirmation of the 'fitness for use' aspect; students can discern what they want and know what suits them and what information they would like and how. [EP5] has also this to say:

> "[W]hat [the students] prefer is that one time looking at videos is good, but maybe summary of that in terms of lecture notes is something that they like. And they like the lecture notes to be fairly comprehensive so that serves as a material that they can spend time (on) and not get distracted by this link, that link …"

3) Platform software characteristics

It is not the case that the technical characteristics

of the platform have no bearing at all on the quality. Respondent [EP4] mentions technical issues they faced:

[EP4]: Interruptions, technical disruptions are there. Mostly network-related. But (the platform) offers alternative [a bridge call initiated by the platform] … Students are ok with it.

Here's respondent [EP5] on his experience:

[EP5]: It is highly bandwidth dependent. So if we have infrastructure issues so there will be disruptions, so again we will try to synchronize. So that can sometimes cause … students to get bored …
[Author]: Ok [the students] were obviously dissatisfied, but how deep … or how intense was it?
[EP5]: I think it was ok … I don't think that became a big issue"

What emerges from the above conversations is that most students take technical glitches in their stride. This explains why attributes such as Performance of the platform or system components do not figure in the top list of significant attributes in the findings from the quantitative analysis.

4.2.2. Results for Healthcare Vertical

1) Appropriateness Recognizability

All the interviewed healthcare professionals mentioned getting more patients offline than thru the platform. In some cases, it may be because a specialist is not approached directly but through a general physician first (as in the case of one healthcare service provider [HP1]):

[Author]: Do you have any figures as to how many patients you got through the platform, versus how many patients you got through offline references of the hospital?
[HP1]: No, offline references are only more because we know doctors …, every physician will come across the certain (specialist) … General population will not know. … I get almost 80% of my patients like that only. Only 20% will come through the platform.

But even a doctor [HP8] from a non-allopathic stream, mentions a low figure:

[HP8]: Most of the patients who come to me are through word of mouth …
[Author]: So, percentage-wise, say, how much would you say, 50-50%? [Or] 80-20?
[HP8]: Maybe 10% of patients come through Practo.

This indicates that the main focus of patients are the doctors who treat them, and not how the doctors are reached. So the platform is 'appropriate' for their needs only to the extent that it provides them access to the doctor. This is reflected in the Quantitative results, where Appropriateness Recognizability, though significant, is not as correlated with the satisfaction rating as the service quality attributes.

2) Software quality attributes

Service provider [HP1] has the following to say when asked about what the platform enables for him:

You can display the money which you are going to charge, the amount is also there, the timings …, everything. That is good… The supportive thing, what they give is perfect.

Another service provider [HP3] too was upbeat about the platform's use for her:

"It offers me a database to keep track of the prescriptions and patients' information, and offers more visibility".

So the doctors who use the platform, find good support from the platform in terms of the functionality and software quality on offer. But these are just some of the doctors; others may be seeing only a limited role for platforms, as was explained by one of the service providers [HP2], when asked whether healthcare as such was offline or online-oriented:

Offline – for two reasons. One, it protects the doctor legally. I have had offers to pay me money to give medical advice online, but I have turned it down, as I cannot give advice without seeing the patient. ⋯ Secondly, for effective quality of Healthcare, it's necessary to assess the patient in person.

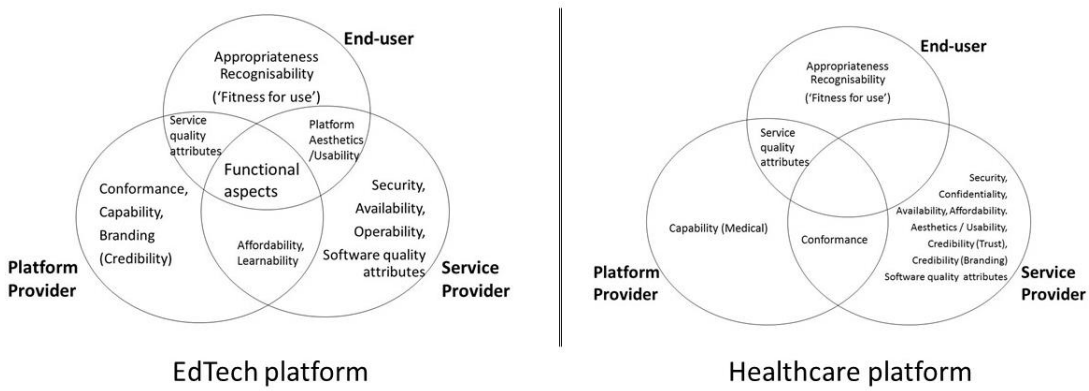
So, the adoption of the platform by the service providers is not widespread; it seems to happen in pockets and its use continued by doctors who have found some value in using the platform.

Ⅴ. Conclusions

The findings from the previous section can be broadly summarized as shown in the two diagrams (depicting the significant attributes for the two verticals) in <Figure 4>.

Each circle has within it the quality attributes which the respective stakeholder expects or seeks from the platform. The attributes exclusively in one's circle represent those attributes which only they are interested in obtaining from the platform and typically seek from the other provider. For example, in EdTech, only the Platform Provider (PP) is concerned with the brand (credibility) of the platform and looks to the Service Provider (SP) to provide the same. Likewise, only SPs are concerned with software quality attributes and expect its provision from the PPs. (There is no attribute which PPs or SPs can be said to expect from End-Users, as they are the primary beneficiaries of the interactions on the platform).

Attributes in intersecting areas denote that both the stakeholders are interested in those attributes being provided on the platform. In case of intersecting areas between PPs and SPs, the particular attribute may be provided by either stakeholder depending upon the business model employed by that platform. Functional aspects (suitability, appropriateness, correctness, completeness) in EdTech are the only attributes which are of interest to all stakeholders on the platform.



<Figure 4> Synthesis of the Significant Attributes

5.1. Implications for Platform Providers

Drawing on the findings from the previous section, four major attributes (or groups of attributes) draw attention regarding digital platforms. These four aspects are:

1) Service quality characteristics of Service Provider

This aspect was important from the user's viewpoint in both EdTech and Healthcare verticals. This is not surprising, given that in both verticals, there is a human element (teacher and doctor, respectively) who interact with the users and provide the service (teaching and medical treatment, respectively). Platform providers too were interested in the success of the SPs. The service quality characteristics like competence and communication are a part of the ten general dimensions of service quality mentioned by Zeithaml, et al. (1990). Time-sensitiveness, too, can be grouped in this category.

2) Functional Suitability and sub-characteristics

These are part of the product quality attributes under ISO 25010:2011 and reflects the quality of the platform or system functionality. These may be either software or non-software elements. SPs showed a moderate interest in the successful provisioning of these functionalities. This is because the SPs are largely the providers of goods or services, or, in rare cases, are the medium through which the delivery of such content to the end-user happens. In such cases, they have to be assured of the quality of such content.

From an end-user perspective, these characteristics were very important for users in EdTech and, though present, not statistically significant in Healthcare. This is explained thus: In the case of EdTech platforms, the delivery of content happens on the platform. Thus the end-user is in direct reception of the content and is directly evaluating the correctness, completeness and adequacy of the content all the time. Thus functional suitability (and its sub-characteristics) play a major role. But in the case of Healthcare, the representative platform is basically an enabler and content delivery (i.e., the medical treatment) happens offline. Hence the functional aspects of the platform are not that significant.

As a matter of fact, in Healthcare, the above logic regarding Functional sub-characteristics is true for some of the other attributes like credibility (of the platform provider) and affordability as well. Presence of these attributes are important for service providers to continue to endorse the platform. But these attributes are not key for end-users as for them the platform is only an enabler.

3) Platform software characteristics

The quality of the technical aspects of the platform are important for SPs in both verticals. The reason here is the same as for functional characteristics. The SPs are the user-facing entity and any drop in quality of the digital entity which was the first point of contact with the user, may cause the user to view their services in a bad light, hence the SPs are understandably anxious that the platform have good quality from a technical standpoint. This is essentially product quality they are seeking.

For the users, apart from Usability, other platform software characteristics, as such, were not important. Again here the reason is the same as that for functional characteristics. In EdTech the core engagement happens on the platform, hence it is very important for the user that the platform's user interface be of quality and the teaching/ learning interaction happen smoothly. But in Healthcare, as the engagement happens offline, the platform is just an enabler and the users seem to take platform non-performance

in their stride.

4) Appropriateness recognizability

This characteristic was added in ISO 25010 and imparts the 'fitness for use' aspect highlighted by Juran and is a user-based view of quality. This characteristic hence manifests itself as being important in the eyes of both SPs and users.

From the above discussion, four implications or aspects which platform providers need to take care of, emerge:

1) SPs with desired service quality attributes like competence, good communication, responsiveness, time-sensitiveness and understanding (the so-called 'soft skills') need to be chosen. This is irrespective of whether the platforms have in-house or external SPs; the people who engage in the value-creating interaction with the user need to have these skills. By implication this applies also to users if they turn SPs – if a platform encourages "side-switching" (Parker et al., 2016, p. 26), it stands to lose if its users-turned-SPs do not have these attributes.

2) Content suitability and adequacy, completeness and correctness, and the platform functionality which helps the SPs to deliver this are important, especially in verticals where content delivery happens on the platform.

3) Platforms cannot get away by saying they are 'technology companies' in all cases. The technology used for platform design and operation (which enables aesthetics, usability and Performance efficiency of the platform) is undoubtedly important. But the importance and implications of technology usage is more in platforms where content delivery happens on the platform, and lesser where the platform may be just an enabler. The business model and governance aspects of the platform also need to be kept in mind.

4) The chosen combination of content and delivery mechanism should be 'fit for use'. Platform providers need to keep in mind their target audience and whether the measures adopted to reach their customers are really serving their main purpose. As Parker et al. (2016) state when describing metrics for platforms – "In the end, the most important metric is a simple one: the number of happy customers on every side of the network who are repeatedly and increasingly engaged in positive, value-creating interactions" (p. 202).

5.2. Limitations and Scope for Future Work

The demographic information of the users was not available from the platform data. Hence it was not possible to assess whether any factors related to age, gender, location, occupation or other social factors could influence the user feedback. Also, only two platform verticals – EdTech and Healthcare – are examined in this paper, and, in the case of Healthcare, using the feedback data from only one platform. The number of service provider interviews done for EdTech and Healthcare is disproportionate due to the lesser number of Healthcare platforms and feedback data available on those platforms. User feedback data from other similar platform in other verticals should be analyzed to confirm these findings or throw light on any differences between platforms. For instance, security of the platform may be an important quality attribute for e-commerce platforms.

Acknowledgements

The help provided by UpGrad in making available the feedback data from their education platform, is gratefully acknowledged.

<References>

[1] Allahbakhsh, M., Benatallah, B., Ignjatovic, A., Motahari-Nezhad, H. R., Bertino, E., and Dustdar, S. (2013). Quality control in crowdsourcing systems: Issues and directions. *IEEE Internet Computing, 17*(2), 76-81.

[2] Axelsson, J., and Skoglund, M. (2016). Quality assurance in software ecosystems: A systematic literature mapping and research agenda. *Journal of Systems and Software, 114*, 69-81.

[3] Behkamal, B., Kahani, M., and Akbari, M. K. (2009). Customizing ISO 9126 quality model for evaluation of B2B applications. *Information and Software Technology, 51*(3), 599-609.

[4] BusinessDictionary.com. Website. Accessed April 09, 2018, at http://www.businessdictionary.com

[5] Cavano, J. P., and McCall, J. A. (1978, January). A framework for the measurement of software quality. In *ACM SIGMETRICS Performance Evaluation Review* (Vol. 7, No. 3-4, pp. 133-139). ACM.

[6] Changing Gears 2020. (2017) Retrieved 18-May-2017 from http://www.bain.com/publications/articles/changing-gears-2020.aspx

[7] Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (pp. 146-166). Upper Saddle River, NJ: Prentice Hall.

[8] Crosby, P. B. (1980). *Quality is free: The art of making quality certain*. Mentor.

[9] Dictionary.com. Website. Accessed April 10, 2018 at http://www.dictionary.com

[10] Emerson, R. M., Fretz, R. I., and Shaw, L. L. (1995). *Writing Ethnographic Fieldnotes*. University of Chicago Press.

[11] França, J. M., and Soares, M. S. (2015). SOAQM: Quality Model for SOA Applications based on ISO 25010. In *Proceedings of the 17th International Conference on Enterprise Information Systems* - Volume 2, pp. 60-70.

[12] Gawer, A., and Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3), 417-433.

[13] Gray, P. S., Williamson, J. B., Karp, D. A., and Dalphin, J. R. (2007). *The research imagination: An introduction to qualitative and quantitative methods*. Cambridge, UK: Cambridge University Press.

[14] Hagiu, A., and Rothman, S. (2016). Network effects aren't enough. *Harvard Business Review, 94*(4), 17.

[15] Haile, N., and Altmann, J. (2016). Value creation in software service platforms. *Future Generation Computer Systems, 55*, 495-509.

[16] Hasan, L. A., and Al-Sarayreh, K. T. (2015, November). An integrated measurement model for evaluating usability attributes. In *Proceedings of the International Conference on Intelligent Information Processing, Security and Advanced Communication* (p. 94). ACM.

[17] International Organization for Standardization. (2001). *International Standard: ISO 5127: Information and Documentation, Vocabulary*. ISO.

[18] Iqbal, H., and Babar, M. (2016). An approach for analyzing ISO/IEC 25010 product quality requirements based on fuzzy logic and likert scale for decision support systems. *International Journal of Advanced Computer Science and Applications, 7*(12), 245-260.

[19] ISO/IEC 25010:2011(en). *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models*. Accessed 17-Oct-2019 at https://www.iso.org/obp/ui/#iso:std:iso-iec:25010:ed-1:v1:en

[20] Juran, J. M., and Godfrey, A. B. (1999). *Juran's quality handbook* (5th ed). McGraw-Hill.

[21] Kang, S., Suh, H., and Kym, H. (2015). The role of interpersonal trust in on-line learning communities and application of knowledge. *Asia Pacific Journal of Information Systems, 25*(4), 642-661.

[22] Kaur, P., and Singh, H. (2015). An analytical review of quality attributes of service-oriented architecture. *Trends in Information Management, 10*(1), 40-50.

[23] Kazan, E., and Damsgaard, J. (2016). Towards a

market entry framework for digital payment platforms. *Communications of the Association for Information Systems, 38*(1), 37.

[24] Kim, Y. Y., and Kim, M. H. (2016). What are software developers' and medical experts' priorities for adopting a healthcare software platform? *Indian Journal of Science and Technology, 9*(24).

[25] Kulkarni, A., Gutheim, P., Narula, P., Rolnitzky, D., Parikh, T., and Hartmann, B. (2012). Mobileworks: Designing for quality in a managed crowdsourcing architecture. *IEEE Internet Computing, 16*(5), 28-35.

[26] Moazed, A. (2018). *8 Big Predictions for Platforms in 2018*. Retrieved 4-Apr-2018 from https://www.inc.com/alex-moazed/8-predictions-for-2018-platform-edition.html

[27] Moon, J. O., Lee, H., Kim, J. W., Aktas, E., Tsohou, A., and Choi, Y. (2015). Customer satisfaction from open source software services in the presence of commercially licensed software. *Asia Pacific Journal of Information Systems, 25*(3), 473-499.

[28] Nandakishore, K. N. (2018). *Design of quality of service framework for digital platforms*. Unpublished Master of Science by Research Thesis. International Institute of Information Technology Bangalore, Bengaluru, India.

[29] One Stop Testing. (n.d.). Retrieved 20-Dec-2017 from http://www.onestoptesting.com/quality-management/quality-factors.asp

[30] Online Education Market in India 2016-2020. (2016). Retrieved 1-Jan-2018 from https://www.technavio.com/report/india-education-technology-online-market

[31] Ouadoud, M., Chkouri, M. Y., Nejjari, A., and El Kadiri, K. E. (2016). Studying and analyzing the evaluation dimensions of e-learning platforms relying on a software engineering approach. *International Journal of Emerging Technologies in Learning (iJET), 11*(01), 11-20.

[32] Pärnänen, K. (2016). *What makes a satisfying user experience in the context of human-computer interaction?* Master's thesis. MSc program in Information and Service Management, Department of Information and Service Economy, Aalto University School of Business.

[33] Parker, G. G., Van Alstyne, M. W., and Choudary, S. P. (2016). *Platform revolution: How networked markets are transforming the economy--and how to make them work for you*. WW Norton & Company.

[34] Ruutu, S., Casey, T., and Kotovirta, V. (2017). Development and competition of digital service platforms: A system dynamics approach. *Technological Forecasting and Social Change, 117*, 119-130.

[35] Software Dependability. (n.d.). Presentation. Retrieved 21-Mar-2017 from groups.umd.umich.edu/CIS/course.des/cis376/ppt/lec9.ppt

[36] Suri, R., and Monroe, K. B. (2003). The effects of time constraints on consumers' judgments of prices and products. *Journal of Consumer Research, 30*(1), 92-104.

[37] Tellis, G. J., Yin, E., and Niraj, R. (2009). Does quality win? Network effects versus quality in high-tech markets. *Journal of Marketing Research, 46*(2), 135-149.

[38] YourDictionary. Website. Accessed 20-Dec-2017 at http://www.yourdictionary.com

[39] Zeithaml, V. A., Parasuraman, A., and Berry, L. L. (1990). *Delivering quality service: Balancing customer perceptions and expectations*. Simon and Schuster.

[40] Zhu, F., and Iansiti, M. (2012). Entry into platform based markets. *Strategic Management Journal, 33*(1), 88-106.

<Appendix A> List of Attributes and their Definitions

The attributes are listed in alphabetical order. Text in brackets indicates the definition reference.

Attribute	Definition
Access	Approachability and ease of contact (Zeithaml et al., 1990)
Accessibility	Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use (ISO/IEC 25010:2011)[6]
Accountability	Degree to which the actions of an entity can be traced uniquely to the entity
Adaptability	Degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments
Aesthetics / UI aesthetics	Degree to which a user interface enables pleasing and satisfying interaction for the user
Affordability	The extent to which something is affordable, as measured by its cost relative to the amount that the purchaser is able to pay (YourDictionary, n.d.)
Analysability	Degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified
Appearance	The state, condition, manner, or style in which a person or object appears (Dictionary.com, n.d.)
Appropriateness Recognizability	Degree to which users can recognize whether a product or system is appropriate for their needs.
Authenticity	Degree to which the identity of a subject or resource can be proved to be the one claimed
Availability	Degree to which a system, product or component is operational and accessible when required for use
Capability	Measure of the ability of an entity (department, organization, person, system) to achieve its objectives, specially in relation to its overall mission (BusinessDictionary.com, n.d.)
Capacity	Degree to which the maximum limits of a product or system parameter meet requirements
Co-existence	Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product
Comfort	Degree to which the user is satisfied with physical comfort
Communication	Keeping customers informed in language they can understand and listening to them (Zeithaml et al., 1990)
Compatibility	Degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment
Competence	Possession of the required skills and knowledge to perform the service (Zeithaml et al., 1990)
Conciseness	The extent (to which) no excessive information is present (in the software product) (One Stop Testing)
Confidentiality	Degree to which a product or system ensures that data are accessible only to those authorized to have access
Conformance	Certification or confirmation that a good, service, or conduct meets the requirements of legislation, accepted practices, prescribed rules and regulations, specified standards, or terms of a contract (BusinessDictionary.com, n.d.)
Context completeness	Degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in all the specified contexts of use

6) All definitions in Appendix A are from this reference unless mentioned otherwise.

<Appendix A> List of Attributes and their Definitions (Cont.)

Attribute	Definition
Courtesy	Politeness, respect, consideration, and friendliness of contact personnel (Zeithaml et al., 1990)
Credibility	Trustworthiness, believability, honesty of the service provider (Zeithaml et al., 1990)
Dependability	The extent to which a critical system is trusted by its users (Software Dependability, n.d.)
Effectiveness	Accuracy and completeness with which users achieve specified goals
Economic risk mitigation	Degree to which a product or system mitigates the potential risk to financial status, efficient operation, commercial property, reputation or other resources in the intended contexts of use
Efficiency / Performance efficiency	The amount of computing resources and code required by a program to perform a function (Cavano & McCall, 1978, January) Performance relative to the amount of resources used under stated conditions Resources expended in relation to the accuracy and completeness with which users achieve goals
Environmental risk mitigation	Degree to which a product or system mitigates the potential risk to property or the environment in the intended contexts of use
Fault-tolerance	Degree to which a system, product or component operates as intended despite the presence of hardware or software faults.
Flexibility	Degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in contexts beyond those initially specified in the requirements
Functional Appropriateness	Degree to which the functions facilitate the accomplishment of specified tasks and objectives.
Functional completeness	Degree to which the set of functions covers all the specified tasks and user objectives.
Functional correctness	Degree to which a product or system provides the correct results with the needed degree of precision
Functional Suitability	Degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions
Health and Safety risk mitigation	Degree to which a product or system mitigates the potential risk to people in the intended contexts of use
Installability	Degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment
Integrity	Degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.
Interoperability	Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged
Learnability	Degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use
Maintainability	The extent (to which the software product) facilitates updating to satisfy new requirements (One Stop Testing) Degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers
Maturity	Degree to which a system, product or component meets needs for reliability under normal operation

<Appendix A> List of Attributes and their Definitions (Cont.)

Attribute	Definition
Modifiability	Degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality
Modularity	Degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components
Non- repudiation	Degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later
Operability	Degree to which a product or system has attributes that make it easy to operate and control
Pleasure	Degree to which a user obtains pleasure from fulfilling their personal needs
Portability	The extent (to which the software product) can be operated easily and well on computer configurations other than its current one (One Stop Testing) Degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another
Recoverability	Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system
Reliability	The extent (to which the software product) can be expected to perform its intended functions satisfactorily (One Stop Testing) Ability to perform the promised service dependably and accurately (Zeithaml et al., 1990) Degree to which a system, product or component performs specified functions under specified conditions for a specified period of time
Replaceability	Degree to which a product can replace another specified software product for the same purpose in the same environment
Resource utilization	Degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.
Responsiveness	Willingness to help customers and provide prompt service (Zeithaml et al., 1990)
Reusability	Degree to which an asset can be used in more than one system, or in building other assets
Robustness	The extent (to which) the (software) product performs correctly in whichever conditions it finds itself (One Stop Testing)
Safety	System property that reflects the system's ability to operate (normally or abnormally) without danger to system environment (Software Dependability)
Security	Freedom from danger, risk or doubt (Zeithaml et al., 1990) Degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization
Testability	The extent (to which the software product) facilitates the establishment of acceptance criteria and supports evaluation of its performance (One Stop Testing) Degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met
Time-sensitiveness	Degree to which the temporal requirements are met by the actor (human or machine, product or system) when performing its functions[7)]

7) Defined in this paper

<Appendix A> List of Attributes and their Definitions (Cont.)

Attribute	Definition
Trust	Degree to which a user or other stakeholder has confidence that a product or system will behave as intended
Understanding (the customer)	Making the effort to know customers and their needs (Zeithaml et al., 1990)
Usability	Degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use
Usefulness	Degree to which a user is satisfied with their perceived achievement of pragmatic goals, including the results of use and the consequences of use
User error protection	Degree to which a system protects users against making errors

<Appendix B> Coding Examples

EdTech platform

Feedback	Positive Attribute(s)	Negative Attribute(s)	Rating (L to R) - 1 (Very Low) to 5 (Very High)
Awesome lectures by <instructor>. Its great !!	Competence		5
lecture notes not provided. matrix calculations should be provided in a lecture note step by step. lot of confusion. graded questions are completely out of context.		Functional completeness, Functional appropriateness	1,1
Felt sometimes things are moving too fast.		Time- sensitiveness	3
Nice	Appropriateness recognisability		3
<Instructor> could have covered all topics in depth helping the students understand it much better. But overall, this is a good module	Functional appropriateness	Functional completeness	3,2

Healthcare platform

Feedback	Positive Attribute(s)	Negative Attribute(s)	Rating (L to R) - 1 (Very Low) to 5 (Very High)
Well experienced and good convincing doctor	Competence, Communication		4,4
Good ambience...nice doctors☺	Appearance, Appropriateness Recognisability		3,3
Hope for better Doctor friendliness, Explanation of the health issue, Treatment satisfaction		Courtesy, Communication, Functional appropriateness	2,2,2
Visited For AcidityAbdominal Pain Doctor is good and listens to your problem in detail...however the facility at hospital is not very helpful...and u need to wait for more than 1 hr even when they say that it number is in next 5 mins...	Competence, Communication	Responsiveness, Time- sensitiveness	3,4,2,1
Doctor was so friendly, humble and polite. Definitely I recommend him. He doesn't make a hole in your pocket. Got relieved from the pain by evening itself. The treatment is so effective with minimal medicines.	Courtesy, Affordability, Functional suitability		5,5,5

<Appendix C>

Interview questions for EdTech Service Provider

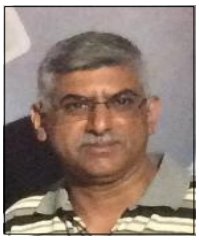
1) Brief background of yourself – Qualifications, teaching experience, arrangement with the Platform Provider (PP), etc
2) Brief background of teaching on the platform – number of courses taught by you, course subject(s), what level, how students are assigned to teachers, whether one-on-one or classroom type of teaching, teaching modes (text / video / Instructor-led / Chat sessions), etc
3) Is course content created by you? Is it reviewed or inputs provided (by either other faculty like yourself, or PP personnel)? How often is it revised?
4) Are there guidelines provided by the PP? If yes, have you ever had a situation where your idea of teaching a subject or concept varied from the guidelines?
5) Are there other content providers involved (example, industry executives, NGOs)? What is the nature of interaction with these others? Does it affect the quality of the teaching? If so, how?
6) What type of queries are asked by students? How are they answered (what is the resolution process)? How do you deal with queries not related to or answerable by you?
7) Are there entry criteria (any test or evaluation) for a student taking up your course? Your opinion on whether any such criteria affects the quality of the teaching and the learning outcomes?
8) Are the courses free or paid courses? What is your opinion on whether it affects the quality of the course?
9) As a content provider (i,e service provider) on a platform, your opinion on what are the important aspects the platform should provide, in such a setup?
10) Do you get feedback on your teaching? From whom do you get feedback (directly from students, or thru the PP)? How often do you get it? What is captured under this? Do you give feedback to students? If so, how?
11) Do you take personal tuitions also? How important is it to you, to relate a face to a name while teaching online? Does it make a difference to the quality of your teaching?
12) Does the platform have tie-ups with educational institutions? How important is it to you, to have a tie-up with a well-known name in teaching? Does it make a difference if the well-known name is online or a brick-and-mortar institution? How important is trust/ credibility of the platform to you?
13) Has there been any technical platform-related disruption during your class? How soon was it rectified? What was the students' reaction to the incident?
14) Your thoughts on the platform functionality and software aspects? How important is the security of the platform to you? Why so?

<Appendix C> (Cont.)

Interview questions for Healthcare (HC) Service Provider

1) Brief background of yourself – Qualifications, service experience, arrangement with the Platform Provider (PP), etc
2) Are there guidelines provided by the PP for any aspect, for example, in interacting with patients on the platform? If yes, have you ever had a situation where your line of thought varied from the guidelines?
3) Are there other content providers involved (example, other healthcare-related providers)? What is the nature of interaction with these others?
4) What type of queries are asked by patients? How are they answered (what is the resolution process)? How do you deal with queries not related to or answerable by you?
5) As a content provider (i,e service provider) on a platform, your opinion on what are the important aspects the platform should provide, in such a setup?
6) Is healthcare as such online- or offline-oriented? How important is it to you, to have the patient physically be available? Does it make a difference to the quality of your treatment?
7) How important is trust/ credibility of the platform to you?
8) Has there been any technical platform-related disruptions, where patients were affected? How soon was it rectified? What was the patients' reaction to the incident?
9) Your thoughts on the platform functionality and software aspects? How important is the security of the platform to you? Why so?

◆ About the Authors ◆



Nandakishore K N

Nandakishore K N holds a Master of Science by Research (MSR) degree from the International Institute of Information Technology, Bangalore (IIIT-B) and is currently working as a Research Associate in the IT and Society (ITS) domain at IIIT-B. He has a B.E from Bangalore University. Nandakishore joined IIIT-B with an experience of more than 20 years in the IT industry, which included roles in project and quality management across a number of domains like Hi-Tech, Banking and Financial Services, and Engineering Services.

V Sridhar

Dr. V Sridhar is Professor at the Centre for IT and Public Policy at IIIT-B. He is the author of three books on ICT policies and regulation and has authored many research papers on telecom and IT in peer-reviewed international journals. Dr. Sridhar has taught at many Institutions in the USA, Finland, New Zealand and India, and was the recipient of Nokia Visiting Fellowship. He has received many international funding awards for his research, most recently from Facebook and Azim Premji University. Dr. Sridhar has a Ph.D. from the University of Iowa, U.S.A., Masters in Industrial Engineering from NITIE, Mumbai, and B.E. from the University of Madras, India. His work can be accessed at: http://www.vsridhar.info.

T K Srikanth

Dr. T K Srikanth is Professor in the Data Sciences group and a member of the E-Health Research Center at IIIT-B. He works in the areas of computer graphics and geometric modeling, data analysis and machine learning, and the design of internet and mobile applications, with a focus on health care. He obtained his Ph.D. in Computer Science from Cornell University, and has a B.Tech (Mech. Eng) from the Indian Institute of Technology, Madras. He has worked for about 30 years in the software industry, in technology, business and product management roles, across a range of technologies and products.

Submitted: March 26, 2019; 1st Revision: October 21, 2019; Accepted: November 22, 2019