Contextualization of the Trialability Concept in the SaaS Model for Mobile and Ubiquitous Environment Deployed in Public Cloud

Possibilities, limitations, mitigations, cost and, measures for mobile SaaS (free trial) potential adopters

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***Abstract*—In this research a generic commercial Software as a Service (SaaS) product offered in the mobile marketplace and deployed in a public cloud is analyzed in order to: (i) identify the possibilities and limitations of the "free to try" version in cloud computing environment; (ii) highlight the cost of the free trial; (iii) determine the correspondence between the "free to try" version and the one available after an onerous subscription contract; (iv) make reference to a series of metrics for measuring the intention to use the application, its effective and real use of available resources. The paper aims to facilitate an educated informed adoption (or rejection) with respect to a mobile SaaS commercial product deployed in public cloud, during the free trialability period, evaluating the SaaS characteristics and functionalities jointly with some perceptions and measures which could arise from its active use, inspection and consideration.**

Keywords-Trialability; SaaS; Software as a Service; SaaS Trialability Cost; SaaS Trialability Factor; Potential Adoption Index.

I. INTRODUCTION

The vast availability of mobile software applications exploitable in ubiquitous environment together with the accessibility of public shared information/opinions on the functionality from earliest adopters (with the rate of downloads) is normally utilized as the first hint for later adopters in the selection of an application.

Cloud Computing (CC)[1] is defined from the National Institute of Standards and Technology (NIST) as a *"model for enabling ubiquitous, convenient, on-demand network access…"*

The availability of specialized platforms for the distribution of mobile software products through the Internet (marketplace) allows the identification of different ubiquitous products offered through a public offer.

The functionalities offered by search engines allow an easy identification of potentially valid products for mobile and ubiquitous environment under different types of platforms (e.g., Windows, iOS, Android, etc.). Information and opinions on the software product, the producer, the developer, the facilities are normally publicly accessible, as well as the indication of the provider's website. The possibility of free testing ("free to try") is usually offered on products in the commercial mobile market. They can be downloaded directly from one or more websites free of charge (marketplace, supplier site, etc.).

The free trial period, under certain condition explicated in this research, could be used to prove and investigate the characteristics of CC application and how the SaaS provider has implemented, incorporated or subcontracted them, within the public offer he advertises in the marketplace.

Fig. 1 represent a new and unpublished graphical visual model image of the complexity available and the necessary elements for a SaaS application to be considered as cloud: (i) Quadrant I represents the horizontal layer of the CC service models; (ii) quadrant II the vertical layer of the CC essential characteristics; (iii) quadrant III the CC deployment models layer (community has been omitted for legibility) and, (iv) quadrant IV visualizes all possible combinations of all previous layers.

The authors underline that, as in Fig. 1, all the defined CC essential characteristics [1] should be present or at least contractually available in all underlying CC service models.

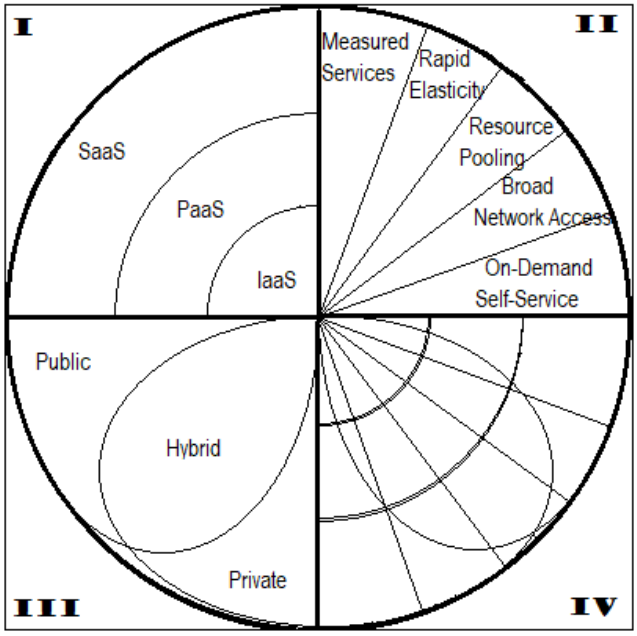

Figure 1. Graphical visual model image of complexity available and needed for a SaaS to be pondered as Cloud Computing application. Source: Drawn up using The NIST Definition of Cloud Computing [1].

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Quite often, for marketing reasons and without considering the verticality of CC essential characteristics, the web-based applications advertised as cloud computing solution are identified as "cloud washing" [2], [3].

It is possible to speculate that Software as a Service (SaaS) products for mobile devices that are actively tested before engaging in an onerous contract offer a lower risk and error assessment than those that cannot be proven in advance (before the contract acceptance and payment). The use in probation: (i) can generate perceptions and/or preventive verifications deriving, even if only, from a limited basis usage and (ii) dependent on the degree of aptitude and/or knowledge of the possible future adopter.

In this paper, the concept of trialability as *"the degree to which an innovation can be experienced on a limited basis ..."* [4] is contextualized in the technological scope of Cloud Computing (CC) [1] jointly with the prospect of a free trial period, more often than not, offered by the SaaS providers.

The trial period or trialability has been revealed as relevant for the adoption or selection of a SaaS product in [5]-[13].

The original concept of trialability [4] is analyzed, contextualized in the Cloud Computing paradigm [1] and presented here in explicit and elucidate details, not yet evidenced in any scientific literature to date.

The following new and original contributions are presented: (i) SaaS Trialability Factor (SaaS_TFct) and its related "Intention of Use" experiment; (ii) SaaS Trialability Cost (SaaS_TCst) and considerations; (iii) extended graphical representation, as part of the case study validation, for the Potential Adoption Index (PAI) [14].

The structure of the paper is as follows. In Section II, a free trialability analysis of a generic mobile SaaS application is presented under three sub-sections: (A) concurrent possibilities; (B) potential limitations, and (C) mitigation. In Section III, a descriptive computation of the SaaS Trialability Cost (SaaS_TCst) related to the adopting or rejection process through the SaaS free trial period is presented. A new concept of SaaS Trialability Factor (SaaS_TFct) is introduced in Section IV, in order to base the construction of a practical model for evaluating the intention (to continue) to use (or reject and dismiss) a SaaS application, after an active and monitored free trial period, by a single non-SaaS-expert user and some measurements. In Section V, the validate model Potential Adoption Index (PAI) is contextualized and briefly described, for the support of this research, adding new graphs outcome, ready for interpretation, resulting from the original case-study [14].

The aim of this work in progress research, with the definition in concept of trialability contextualized in the SaaS service model, is to allow in real conditions, even if on a limited basis: (i) to anticipate evaluations (ex-ante the onerous subscription contract) by potential interested adopters; (ii) to assist in an informed subscription (or the decommission) of a SaaS service contract through a reflective/formative approach within determined constraints, possibilities, knowledge and available resources while reconciling these decisions with relevant prior research.

II. TRIALABILITY CONTEXTUALIZATION: CONCURRENT POSSIBILITIES, POTENTIAL LIMITATION AND, MITIGATION

In order to arrive to a detailed contextualization, the limitations of trialability concept, as proposed by Rogers [4] in the Diffusion of Innovation theory, is detailed exclusively in light of a generic SaaS mobile application "pay as you go" deployed in public clouds where the SaaS provider offers a free trial period, because it is possible to detect, through direct observation, the combined presence of concurrent possibilities, potential limitation, and mitigations.

A. Concurrent possibilities

- The SaaS product is offered to anyone through a global public offering (public cloud deployment model) in/and through the Web (broad network access characteristic);
- A user can unilaterally access and use the program autonomously (on-demand self-service characteristic) through the network (broad network access characteristic);
- The SaaS offered during the free period:
  - has the same technical and functional features of the purchased product in case of subscription agreement acceptance (the multitenancy future in SaaS does not allow, still, an easy implementation of functional differentiation and all users normally use the same application [15] and [16]; customizations should be done through configuration [17]);
  - can be used without any installation (web version), on any device that supports a web browser compatible with the SaaS software and/or can be installed and used on all mobile devices available (mobile version), compatible with the SaaS platform offered by the provider (Android, iOS, etc.), without any limitation in number (pay per use and not by physical device or per-seat license);
- The SaaS provider normally guarantees:
  - free versions upgrades/updates also during the free trial period (multitenancy future);
  - the possibility of unlimited use of the virtualized resources offered through the SaaS application (resource pooling and rapid elasticity characteristics);
  - full access (in same case limited) of all support services offered by the provider in the exclusive context of the SaaS application execution;
- Usually the SaaS application utilization is free of charge during the free period also for commercial use even in the case of business applications (e.g., invoicing, accounting, etc.).

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B. Potential limitations

- The access to the SaaS program is possible only for a limited number of users (typically one), but all authorized users (typically one) can alternatively be connected via any of the compatible devices they have availability (mobile and/or web version);
- Virtualized resources provided could be limited during the trial period;
- Same technical or functional features of the SaaS product could be available only after the subscription agreement acceptance and the payment of a fee (e.g., add-ins, extended functionalities, etc.);
- Normally the use of the trial application is free only during a delimited timeframe (generally trial period could be 15-30 consecutive days from the initial user registration).

C. Mitigations

Moreover, it is possible to mitigate the above limitations with a self-administration possibility option to request in on-demand self-service mode, upon payment of a certain sum, calculable and calculated before accepting the contract, any number of users and/or resources and/or features offered by the provider, for an established minimum period of time (days, month, year, etc.) with the assurance of termination (even in advance but with possible penalties), through the same contractual terms and conditions previously known and already subscribed.

With the above, greater precision was sought, based on the same definition used in the field of scientific literature and still maintaining the original limitations proposed by Rogers [4] *"on a limited basis"*, with exclusive reference to the trialability only in the innovation context introduced by the Cloud Computing paradigm with commercial "pay as you go" SaaS application deployed in public cloud that offers a free trial period.

Note that SaaS product offered in the marketplace, because the CC on-demand self-service characteristic, are normally proposed as a unilateral closed public offer. The adopter has only the chance to opt-in only if (additional or alternative) options are offered (e.g. personalization of SLA, emergency plan, different IaaS provider, different levels of support, etc.), by the SaaS provider, during the contract subscription phase or after, altering or renovating, the original contract and solely in on-demand self-service mode.

In a more general and abstract level of interpretation, it is possible to sustain the thesis that a SaaS provider may create a sense of trust in a potential client by (just only) manifesting an intention to create it (free SaaS trialability or free trial with few and fixed formalities). This level of trust can so indirectly be experienced, by using and testing the SaaS application *"on a limited basis"* by the potential client and, eventually, with and through the provider support services and information offered upon request or published on the web.

III. SAAS TRIALABILITY COST (SAAS_TCST)

The "free" trial actually has some hidden, but still identifiable and, evaluable costs for both the SaaS provider and the potential customer.

On the provider's side: (i) he offers the use of the SaaS program (intellectual creation) free of charge; (ii) he is responsible and accountable for the costs incurred in the virtualized environment used (or pays the subcontracted IaaS provider) and related support services; (iii) so that potential customers can experience the application's features in advance and "free" of any cost for their use during the trial period.

The potential client invests his time and, consequently, his money to evaluate the program.

In a very synthetic way and without pretending to present an exhaustive generic case, but in a clarifying way for our purpose, it can be pointed out that the most obvious elements when it comes to knowing the costs of a SaaS trial are here briefly mentioned. The SaaS Trialability Cost (SaaS_TCst) or the cost of the free application trial period should consider for the SaaS provider, the sum, during a limited timeframe, of:

- the temporary use of intellectual creation (or non-depreciation cost for a specific timeframe);
- the effective use of virtualized resources (IaaS and measured service – essential characteristic);
- the effective support/aids provided to the test user from the provider support service representatives;

for the potential customer, the sum of:

- the effective time of use of the SaaS (measured service – essential characteristic);
- learning time to use the program (e.g. Website inspection, self-learning, emails/calls to provider customer support);
- time for any further inspection and obtaining any necessary additional information (including waiting time for provider support issues reply and incidents resolution);

multiplied each one of the above, by the hourly cost dedicated to these activities. The total time is also a function of the physical and mental effort, considered as sufficient, by the user, for the evaluation of the SaaS product.

The in-depth analysis of the software test can, in this way, be adjusted for each potential customer, depending on the degree of interest or application requirements, in order to ensure: (i) a balance between the economic cost of the strategic choice; (ii) the time dedicated to the inspection/ learning/assessment activities and (iii) the physical and mental effort required for these activities. And all this, within a free timeframe limited by the SaaS application provider (SaaS Trialability period).

In other words, it can be said that the cost of a "free trial" of a SaaS program (or the SaaS_TCst) represents a measurable investment (hidden and for consideration) distributed among the parties (SaaS application provider and potential customer).

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It is also possible to identify the value at margin (separation point between acceptance and repudiation), at a given moment in time, of a SaaS application for a generic user, deriving from the total utility generated equal to the cost of the physical and economic components necessary to allocate and execute the application on the mobile device, at a level of use considered by her/him to be minimally adequate and/or free of efforts.

For a detailed Total Cost of Ownership (TCO) approach of Cloud Computing services the proposed TCO method in [18], where a mathematical modeling of cost types is introduced along with a case study, could be used *mutatis mutandis* for additional rationale.

IV. SAAS TRIALABILITY FACTOR (SAAS_TFCT) AND "INTENTION OF USE" WITHIN MEASURED SERVICE CC CHARACTERISTICS FOR A SINGLE NON-SAAS-EXPERT USER

In paid SaaS programs that offer a trial period, it is possible to experiment free operational features *"on a limited basis"* without others human intervention (on-demand self-service characteristic) and autonomously under much more extensive conditions than any other forms of demo-software products that do not use Cloud Computing paradigm [1].

The degree that allows identifying the level of transparency, compliance and correspondence between the version that can be used after an onerous subscription contract and the free trial version is here defined as SaaS Trialability Factor (SaaS_TFct). The SaaS_TFct corresponds to 1:1 only if the limitation of the SaaS trial product is correlated and limited only to the number of granted users who can access simultaneously the application (minimum one user).

In this case, where SaaS_TFct is equal to 1:1 (SaaS_TFct = 1:1), the trial period is fully comparable, from the point of view of the systems, data, information, processes, functions and support to a SaaS application in live operation and under payment contract ("pay as you go" period) for at least a single user.

In fact, more often than not, SaaS providers offers: (i) the use of the SaaS application for trial; (ii) free of all the potential limitations (see Section II B) but not the number of users (normally one) and the time limit (established trialability period); and, (iii) at the same time, all available concurrent possibilities (see Section II A). Only when the three previous conditions are met the SaaS_TFct is equal to 1:1 (*"trialability on a virtually free full basis for at least one concurrent test-user during a no-cost time-period"*).

When the SaaS application has a SaaS_TFct = 1:1 it is possible to let the registered user to perform the desired tests while collecting additional data, in a controlled environment, in order to determine and measure the effective use of the application in terms of the amount of time and resources used (see the vertical layer of CC measured service essential characteristic in Quadrant IV of Fig. 1 crossing all underlying CC service models from SaaS to IaaS).

The CC Effective Use (CC_EU) can be captured (or logged) in automatic mode, when/if needed, for any registered user accessing the SaaS: (i) at application level (e.g., frequency of use, duration of use, nature of use, number of functions or features used, etc.); (ii) at virtualized hardware level (IaaS) (e.g., CPU used, memory allocated, hard drive space used or read/write, etc.); (iii) analytically and; (iv) in aggregate form for statistical purpose.

For any registered user, the SaaS provider in addition to "transactional use" (CC_EU at the application level), could collect additional data on "informational use" and "customer-service use" through his web site and with the same login credential already granted to the potential adopter during the trial period.

In order to experiment if is it possible, for a single non-SaaS-expert possible adopter, to take a preliminary informed adoption (or rejection) decision at individual-level, respect to a SaaS commercial product, inside a Business Environment Context (BEC), during the free trialability period through:

- a set of predefined data collection items in the form of a simple survey, administered (e.g. in a pop-up modality) to the specific trial user (e.g., triggered when he logs off the application), containing the measurement items for "Usefulness" (U) and "Perceived Ease of Use" (PEU), as described in "Appendix" of [19] without decompose the original model and maintaining the reflective/formative measurement, are here contextualized and reported from the original research, in Table I and Table II;
- a simplified algorithm (Fig. 2) named "SaaS Trialability Algorithm Simple Adoption Process in Business Environment Context for Single-User" (STASAP∩BECxSU) that describes the procedure and contains all essential elements for its coding;
- the code for a randomized STASAP∩BECxSU simulation algorithm using the B.A.S.I.C. programming language (Fig. 3);
- the results of a single run of the coded program STASAP∩BECxSU (Fig. 4);

are here offered in order to facilitate the reader to perform the live experiment in auto evaluation self-service mode of **any** BEC related mobile application she/he eventually has access to.

TABLE I. MEASUREMENT ITEMS FOR "USEFULNESS" (U) AND "PERCEIVED EASE OF USE" (PEU) AS PER THEORETICAL CONSTRUCT IN "APPENDIX" OF [19]

#	Question
1	Using (the SaaS solution) in my job would enable me to accomplish tasks more quickly.
2	Using (the SaaS solution) would improve my job performance.
3	Using (the SaaS solution) in my job would increase my productivity.
4	Using (the SaaS solution) would enhance my effectiveness on the job.
5	Using (the SaaS solution) would make it easier to do my job.
6	I would find (the SaaS solution) useful in my job.
7	Learning to operate (the SaaS solution) would be easy for me.
8	I would find it easy to get (the SaaS solution) to do what I want it to do.
9	My interaction with (the SaaS solution) would be clear and understandable.
10	I would find (the SaaS solution) to be flexible to interact with.
11	It would be easy for me to become skillful at using (the SaaS solution) .
12	I would find (the SaaS solution) easy to use.

As soon as the collected information is inputted, it is possible to calculate the "Intention Of Use" (IOU) as the arithmetical average of all the single measurement items (as a sum of evaluation values for each U and PEU acquired, divided by 12).

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TABLE II. MEASUREMENT SCALES FOR "USEFULNESS" (U) AND "PERCEIVED EASE OF USE" (PEU) AS PER THEORETICAL CONSTRUCT IN "APPENDIX" OF [19]

Evaluation values								
likely	1 - extremely	2 - quite	3 - slightly	4 - neither	5 - slightly	6 - quite	7 - extremely	unlikely

If is it possible to repeat the above measurements at a specific point in time (in the original research [19], after the first hour introduction and, then, after 14 weeks), during the trial period, a differential could be highlighted that would lead to a reasoned acceptance or refusal (depending also on time, methods and resources used in the SaaS tests or the collected CC_EU related measures) making also possible scoreboard the review progression in each of Perceived Ease of Use (PEU) and Usefulness (U) measures.

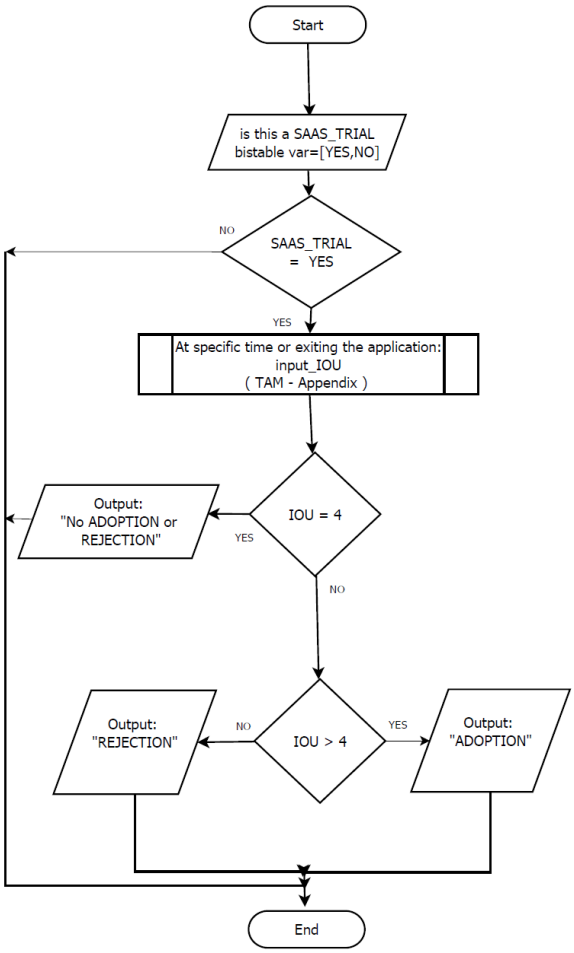

Figure 2. "SaaS Trialability Algorithm Simple Adoption Process in Business Environment Context for Single-User" (STASAP∩BECxSU)

Although the emerging trends of use of big data and powerful analytics place a new emphasis on the use of business intelligence as a source of competitive success, the here proposed experiment, and its calculated result can already provide a clarifying and useful solution (the calculated IOU).

In fact, if the average of IOU is > 4 the probable adopter is prone to adopt the SaaS application; if IOU < 4 the probable adopter, at this point in time, is willing to reject the application for her/his personal use in her/his BEC.

```
10 REM save"SAASAP_BC_SU
15 CLS: RANDOMIZE VAL(MID$(TIME$,7,2)):DIM IOU(100, 12)
20 I=1
30 IOU=0:PRINT "Collecting data for INTENTION TO USE: " :FOR X=1 TO 12:IOU(I,X)=
INT(RND*7+1):PRINT "The answer to Q";X;"is "; IOU(I,X):IOU=IOU+IOU(I,X):NEXT X:I
OU=IOU/12:PRINT: PRINT"*** The last calculated IOU average value = "; IOU:REM **
 randomized IOU
50 TRIAL=0:PRINT "Do you want to TRY more the SaaS application? 0=NO;1=SI";: INP
UT TRIAL:IF TRIAL = 0 THEN GOTO 1000 ELSE PRINT "Please USE again the Applicatio
n and then answer the proposed questions!"
60 REM ********************* gosub Subroutine GET_USEd  *****
100 GOTO 30
1000 PRINT "The computated FINAL decision is: ";:IF IOU = 4 THEN PRINT "Non deci
sion" : GOTO 2000
1010 IF IOU > 4 THEN PRINT "ADOPTION" ELSE PRINT "REJECTION"
2000 END
Ok
```

Figure 3. Coding of SaaS Trialability Algorithm Simple Adoption Process in Business Environment Context for Single-User (STASAP∩BECxSU)

```
Collecting data for INTENTION TO USE:
The answer to Q 1 is  7
The answer to Q 2 is  7
The answer to Q 3 is  5
The answer to Q 4 is  2
The answer to Q 5 is  2
The answer to Q 6 is  3
The answer to Q 7 is  6
The answer to Q 8 is  6
The answer to Q 9 is  1
The answer to Q 10 is  1
The answer to Q 11 is  5
The answer to Q 12 is  5

*** The last calculated IOU average value =  4.166667
Do you want to TRY more the SaaS application? 0=NO;1=SI? 1_
Please USE again the Application and then answer the proposed questions!
Collecting data for INTENTION TO USE:
The answer to Q 1 is  5
The answer to Q 2 is  3
The answer to Q 3 is  3
The answer to Q 4 is  7
The answer to Q 5 is  3
The answer to Q 6 is  3
The answer to Q 7 is  7
The answer to Q 8 is  1
The answer to Q 9 is  2
The answer to Q 10 is  1
The answer to Q 11 is  2
The answer to Q 12 is  2

*** The last calculated IOU average value =  3.25
Do you want to TRY more the SaaS application? 0=NO;1=SI? 0
The computated FINAL decision is: REJECTION
Ok
```

Figure 4. A single run of the program SaaS Trialability Algorithm Simple Adoption Process in Business Context Environment for Single-User STASAP∩BECxSU at two different points in time during the tests with the motivated final decision of rejection (final value = 3.25 < of 4).

In order to analyze and, eventually correlate in more detail, the final (rejection or acceptance) of IOU (calculated with the experimented STASAP∩BECxSU), the End-User Computing Satisfaction (EUCS) [20], experienced during the trial, could also be collected and examined (through the proposed measurement items and scale) with respect to Content (C), Accuracy (A), Format (F), Ease of use (E) and Timeliness (T) constructs as spelled out at p. 268 in [20], using the same tactic previously described for the STASAP∩BECxSU. Alternatively to the latter, collected /able CC_EU measures as: number of functions or/and features used (C_i); duration of each use ($T_{j,i}$); response time ($T_{j,i}$); output produced ($F_{j,i}$); any error reported by the application and/or the end-user (E_i and/or A_i); etc.; could be utilized/analyzed and/or integrated with the eventually available EUCS measures.

V. POTENTIAL ADOPTION INDEX (PAI)

In more complex BEC, where the strategic decision (in adopting a SaaS product deployed in public cloud) can be supported and integrated by an objective quality technical evaluation, the use of the Potential Adoption Index (PAI) described in pp. 145-160 in [14] and, also reported here, in Fig. 5, can be considered (in addition to STASAP∩BECxSU experiment) opportune.

The idea of the PAI has his foundation in [21], where (in Fig. 2, p. 186) the authors proposed, in the suggested research agenda section, the business-technology framework to refer to different views of correlated Cloud Computing scientific research aspects (on business - technology axis).

A PAI preliminary model was developed and subsequently presented in [22] and [23].

If the *trialability on a virtually free full basis for at least one concurrent test-user during a no-cost time-period* (SaaS_TFct = 1:1), is offered by the SaaS provider, it can be used, at an already explained cost (SaaS_TCst), to acquire all the necessary evaluations for the elements incorporated in the PAI model.

The validated PAI model [14]: (i) is generic because can refer to any BEC oriented SaaS deployed in public cloud; (ii) it has been created to assist and support "Decision-Maker not Technically expert in CC" (DMnTeCC), in the adoption decisions of the most apt SaaS product (available on the marketplace).

The single PAI resultant value is represented in numeric form (values range between 1 and 4) in which the two evaluations (business and technology) of all the specific constituent elements, converge in a weighted means, in the result: (i) relative importance of the DMnTeCC; (ii) quality-related to objectively verifiable elements of the services offered (or potentially available) and their modalities.

The 58 constituent selected attribute-elements are, in the PAI model, grouped by: (i) CC essential characteristics as in [1]; (ii) benefits and concerns as proposed in [24].

Each selected element or attribute is (i) uniquely identifiable; (ii) it is characteristic; (iii) it is evaluable by importance and quality; (iv) it is verifiable or testable and; (v) assigned to one or more representative groups or subgroups.

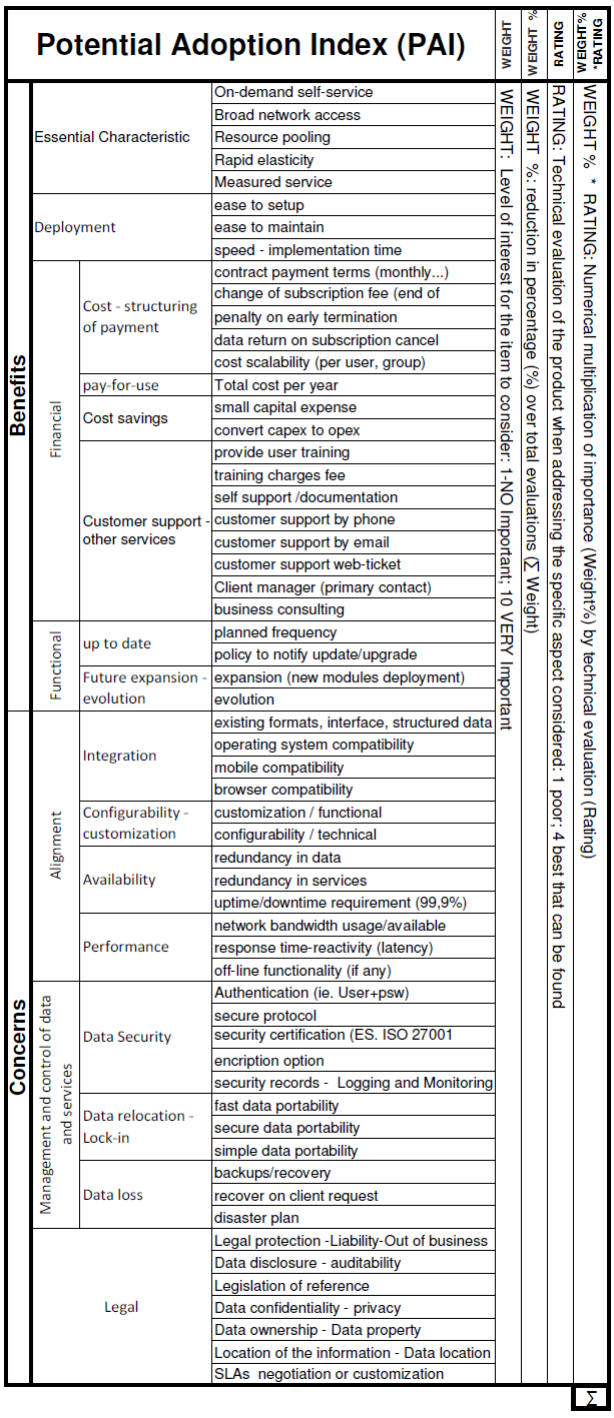

Figure 5. Model for the quantitative data acquisition for the PAI calculation. Source: [14] pp. 145-160.

The technical quality assessment is carried out from a SaaS-Specialized-Technical-EXPERT (SSTE) on an objective basis, made justifiably (susceptible to verification and adequately modifiable) and, using a pre-established discrete fixed scale of integer values (min. 1, max. 4) on an average of 2.5 (valorization not available as evaluation value) as pp. 161-177 in [14].

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Different technical assessments values, on the same SaaS product, may depend on the experience of the SSTE evaluator, the objectivity of the evaluation and, the reproducibility of the measurement or/and its motivated justification.

The evaluation of the importance of each element is made by the DMnTeCC, with values that can be chosen from a preselected scale (usually between 1 and 10), even if this scale is modifiable during the assessment stage (retrofitted in the model, using % of the original Weight acquired in the case study protocol).

Each evaluable element in the PAI model obtains a discrete calculated numerical representation (Weight % * Rating) on: (i) the relative importance for the DMnTeCC (Weight %) and; (ii) quality of the SaaS product for the SSTE (Rating); (iii) in a specific BEC.

The PAI value synthesizes, in an aggregate and final result, the potential of the analyzed SaaS product with respect to the importance/quality attributes values in a specific BEC and, it provides a correct indication in itself, as a result of an agglomerated calculation (Σ of all Weight% * Rating).

The final value of the PAI is able to synthesize a positive potential (for a value greater than 2.5) or negative potential (for a value less than 2.5) between CC essential characteristics, benefits and concerns in relation to the SaaS program and its adoption in a BEC and, still maintains its connotation in terms of importance originally expressed by the DMnTeCC (Weight %).

The computation of the PAI is simple, although it incorporates clearly identified available levels of knowledge of the SSTE and, the explicit DMnTeCC will.

The potential of the PAI model depends exclusively on: (i) the consistency of the model; (ii) the underlying definitions and categorizations; (iii) the selected incorporated component elements; and, (ii) of its controlled use both in professional practice and in academic settings.

A detailed graphic analysis, that keeps in mind the DMnTeCC importance's and technical qualities (carried out from an SSTE), could be performed following the PAI data collection schema in order to visualize all the available information.

It is useful, now, to graphically address the relevance of the Potential Adoption Index (PAI) using, with a chart analysis, the set of evaluations within a Cartesian axis system, which refers to the dimensions of the importance of the DMnTeCC (axis of the ordinates) and the judgments on technical quality expressed from a SSTE (axis of the abscissa) as in Fig. 6, 7, 8 and 9.

The intersection of the axes, in the average value, divides the Cartesian plane into four quadrants to each of which it is possible to associate a different meaning (see Fig. 6).

The new graphic representation, proposed for the PAI model case-study, is much easier interpretable than the tables offered in the original research [14] and allows identifying groups of elements to focus to for additional consideration.

Fig. 6 shows the scatter plot obtained with the answers of the questionnaire in case B with the indication of each characteristic element considered.

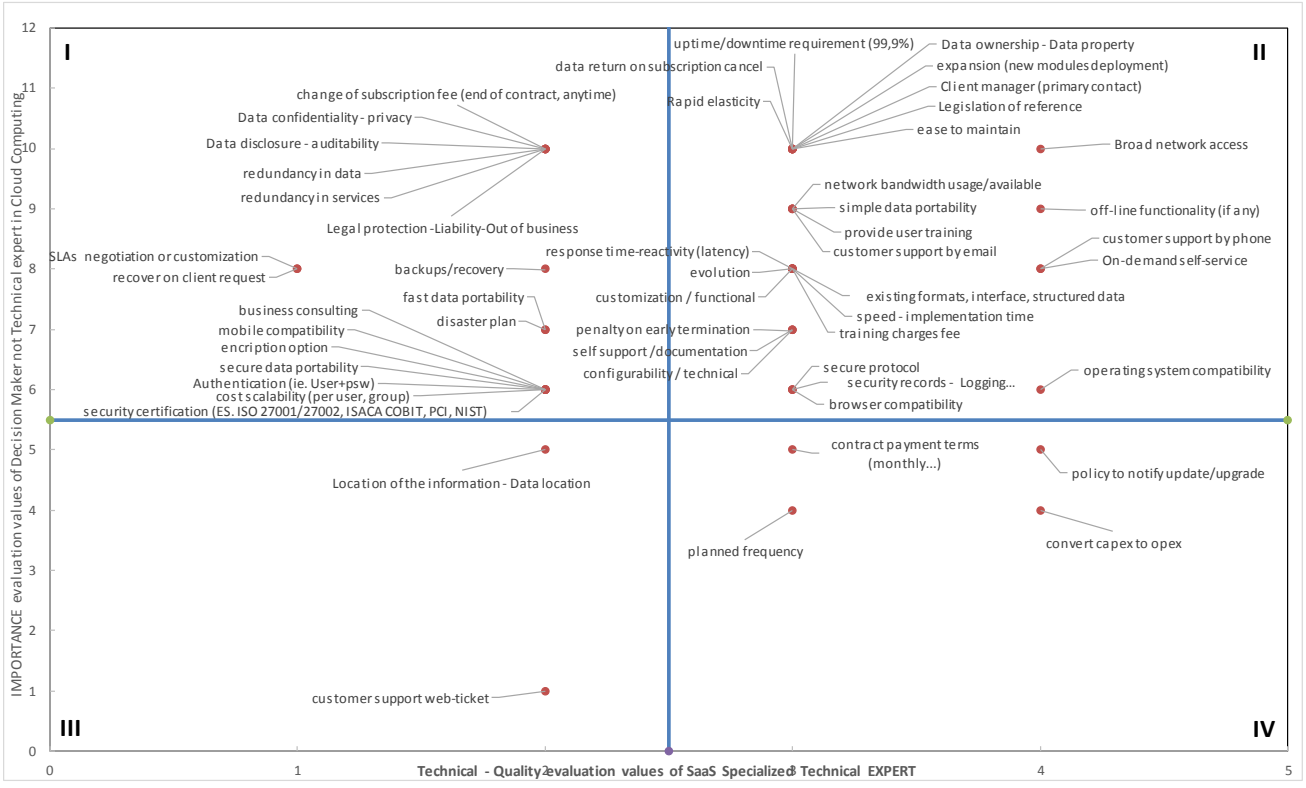

Figure 6. Graph representation of constituent elements of Case B with PAI = 2.7038 at p. 175 in [14].

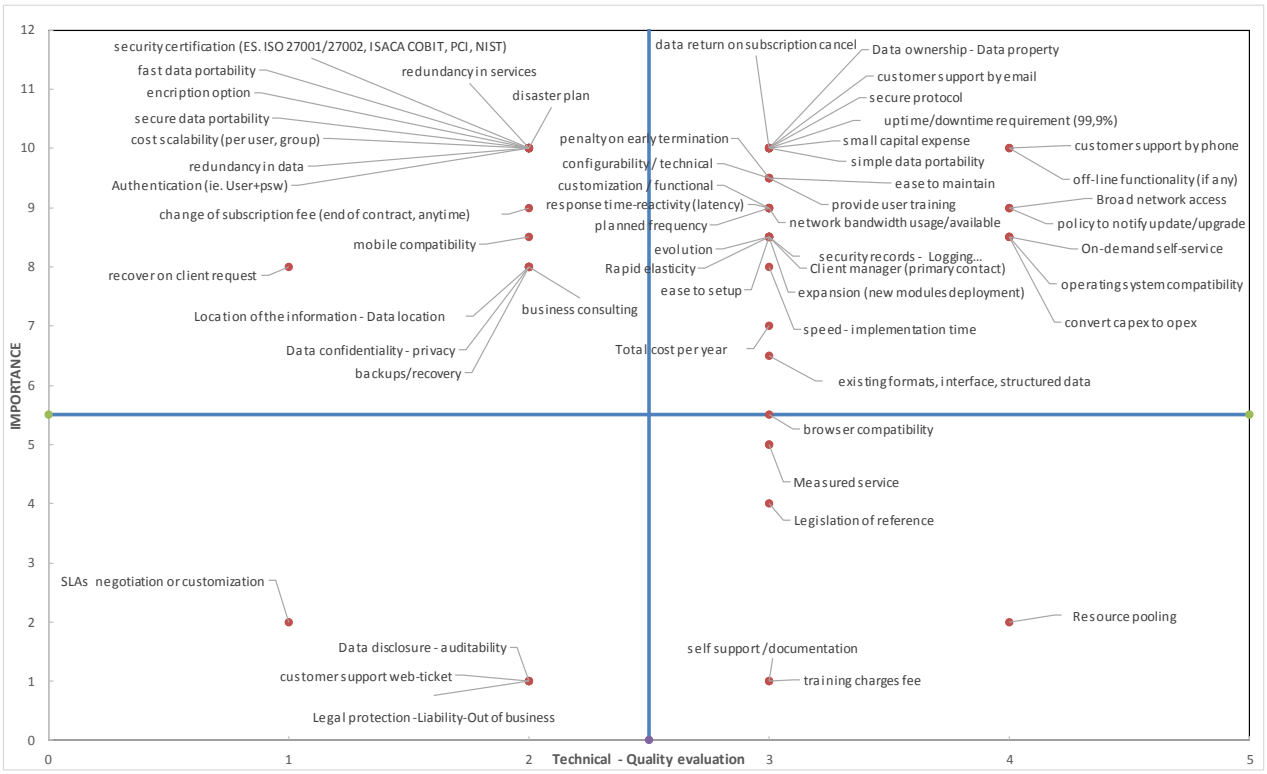

Figure 7. Graph representation of constituent elements of Case C with PAI = 2.7873 at p. 185 in [14].

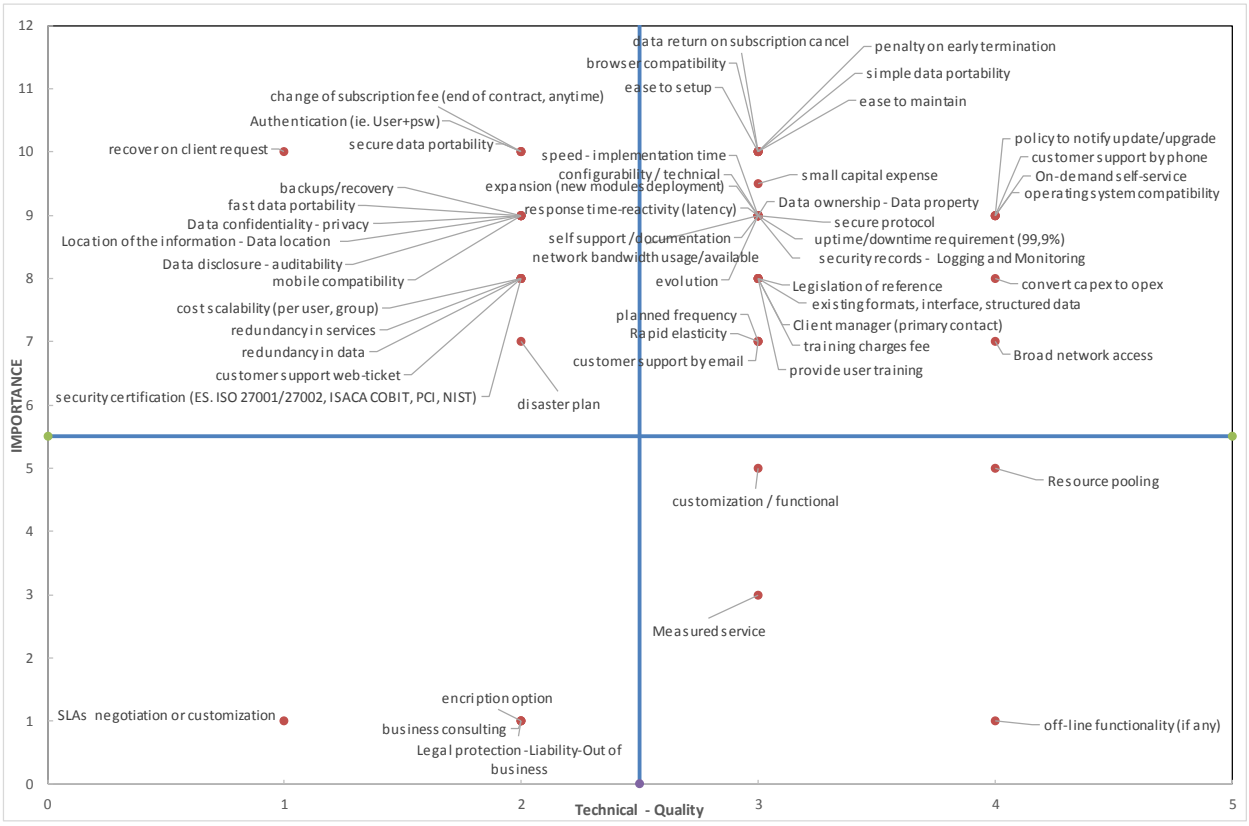

Figure 8. Graph representation of constituent elements of Case D with PAI = 2.7748 at p. 191 in [14].

With this graphic representation, the DMnTeCC of Case B can now focus his attention on the I quadrant (in Fig. 6), with the help of what was reported by the SSTE in "Technical evaluation (Rating) of the analytical elements of the quantitative model" (pp. 161-177 in [14]) for each evaluation element starting with the ones that have the high interest value (Weight) and lowest technical assessment (Rating): Change of subscription fee; Redundancy in data; Redundancy in services; Legal protection-Liability-Out of business; Data disclosure-auditability; Data confidentiality–privacy (as also highlighted in Table 28 at p. 184 in [14]).

Same considerations can be done for Fig. 7 e 8 with the appropriate case differentiation (see Table 31 at p. 190 for case C and Table 34 p. 194 for case D in [14]).

The PAI model and his graphical representation want to be an added and balanced research instrument to support the evaluation of SaaS products in a BCE.

VI. FURTHER WORKS, RECOMMENDATIONS, AND SUGGESTED RESEARCH AGENDA

The PAI data and results obtained in the three case-study in [14] refer to the same SaaS product, and if a sufficient number of cases was available they could be aggregated and analyzed further in conjunction of Fig. 9. In fact, it could be useful to address the adoption potentials of a SaaS product in a BEC using some analogies with the well-known Importance-Performance Analysis (IPA) model [25], originally developed in marketing research and progressively disseminated in social studies, with the due care.

Further subsequent studies, if sufficient data will be available, could lead in revealing solid findings for later adopters and/or could help the SaaS providers to prioritize improvements to their Software as a Service product and at the same time conform to what is defined as CC [1].

VII. CONCLUSION

In the Cloud Computing service models (IaaS, PaaS and SaaS), the essential characteristics are inherited among these layers through the encapsulation of the various offered technological components (that can be also automated if previously subscribed or contracted) and could be made available for the benefit of the end-users.

SaaS programs are supported on IaaS platforms and are normally developed through the use of PaaS platforms.

IaaS providers in public cloud that have accredited platforms are few and distributed in a global geographical scope (e.g., Amazon Web Services; Microsoft Azure; Google Cloud Platform and IBM Cloud, etc.).

Providers that offer SaaS applications can subcontract models of underlying services from other public cloud providers (PaaS or IaaS) by subscribing to the respective published contractual conditions in an on-demand self-service fashion.

The contractual conditions subscribed between different providers impose predetermined contractual obligations that indirectly influence (but could *"de facto"* affect) the final subscribers of the SaaS service.

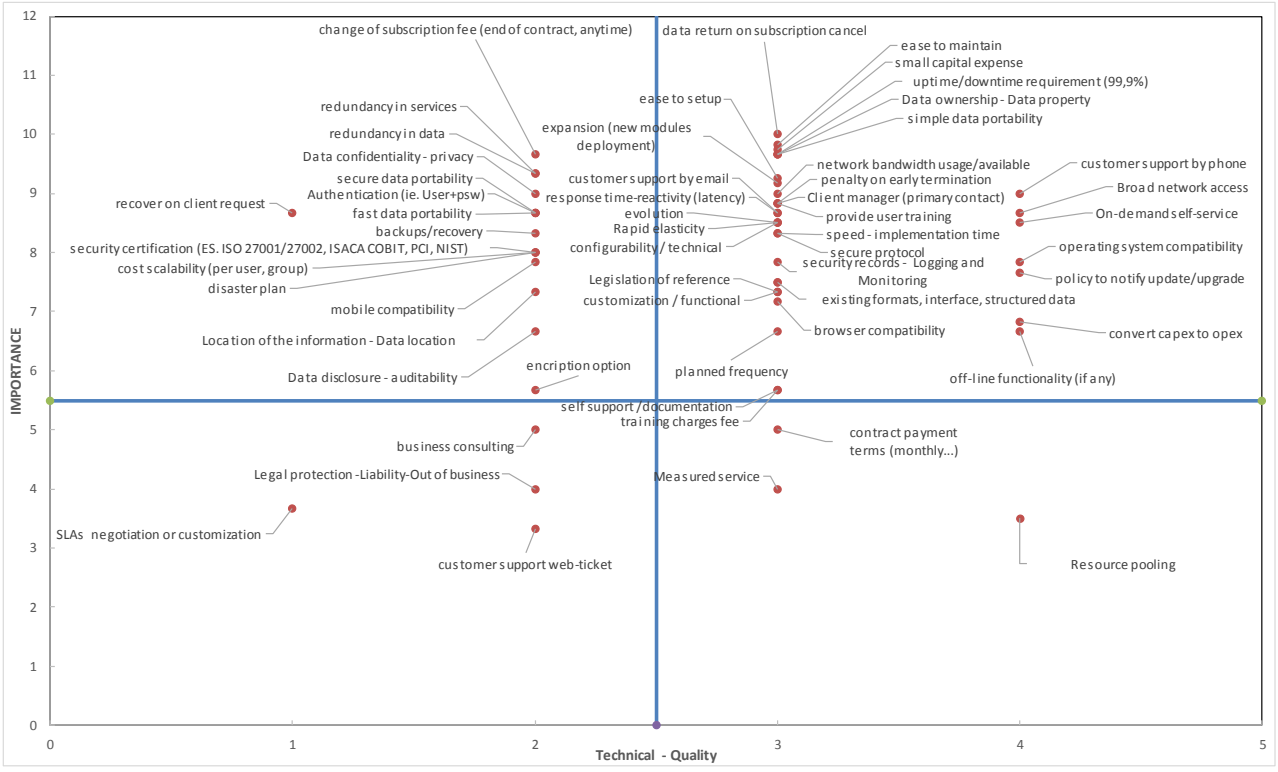

Figure 9. Graph representation of the average of constituent elements of Case B, C, and D not present as a table in [14]

.

When a specific SaaS service is contracted on a subcontracted platform, the subscriber of the application agrees on the use of the program, on a virtualized infrastructure, directly with the SaaS service provider (with levels of visibility and transparency most likely fragmented along the entire chain of supplied sub-contracts).

The contractual and technical responsibilities, "of and in" the services offered by the SaaS provider are shared at different levels among all the actors (all involved providers and the SaaS customers);

The complexity of evaluating the technological component, the contractual links and the offered services (incorporated or explicit), are usually underestimated or ignored until complications arise (e.g., malfunction, loss of data, unfulfilled legal responsibilities, etc.), compromising the effective use of the contracted SaaS service and/or the expected benefits.

The availability of a free trial period (free trialability) of the application is, by the authors, of deep importance to be able to appreciate the operational characteristics and verify the technical and contractual components of the SaaS services offered by the provider before committing to a paid contract.

For what reported in this paper is now possible to affirm that SaaS products for mobile devices deployed in the public cloud and available on the marketplace: (i) that comply with the CC paradigm; (ii) and have a SaaS_TFct equal to 1:1; (iii) and are actively tested (investing sufficient time and effort for their inspection); (iv) in a controlled and measured environment; (iv) during a limited cost-free trialability period offered by the provider; (v) have a lower risk and error assessment than those that cannot be tested in advance (before the contract acceptance and payment) but have, possibly, a higher initial (investment) hidden but measurable cost (SaaS_TCst).

In order to sustain the letter statement, an approach based on diverse subjects with different level of expertise /responsibility and unique measurement items has been used.

The structured approach focused on adoption evaluations of a SaaS product deployed in the public cloud, with inspection/test during the trialability period, by:

- single non-SaaS-expert user;
- decision-maker not technically expert in CC (DMnTeCC) jointly with a SaaS-Specialized-Technical-EXPERT;

using respectively:

- the Intention of Use construct (IOU) metrics;
- the Potential Adoption Index (PAI) research and additional graphic validation examples.

Trialability has been here, therefore, proposed not only as a tangible factor of Diffusion of Innovation in CC environments but also as viable reasoning and learning tool instrument in order to acquire a deeper understanding, knowledge and, data source for personal and scientific research in the evolutionary Cloud Computing paradigm.

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REFERENCES

[1] P. Mell and T. Grance, "The NIST Definition of Cloud Computing," 2011.

[2] A. Adamov and M. Erguvan, "The truth about cloud computing as new paradigm in IT," in *International Conference on Application of Information and Communication Technologies, 2009. AICT 2009*, 2009, pp. 1–3.

[3] W. Venters and E. A. Whitley, "A critical review of cloud computing: researching desires and realities," *J. Inf. Technol.*, vol. 27, no. 3, pp. 179–197, Sep. 2012.

[4] E. M. Rogers, *Diffusion of innovations*. New York; London: Free Press ; Collier Macmillan, 1983.

[5] A. Lin and N.-C. Chen, "Cloud computing as an innovation: Percepetion, attitude, and adoption," *International Journal of Information Management*, vol. 32, no. 6, pp. 533–540, December 2012.

[6] Y. Alshamaila, S. Papagiannidis, and F. Li, "Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework," *Journal of Enterprise Information Management*, vol. 26, no. 3, pp. 250–275, 2013.

[7] B. Ramdani, D. Chevers, and D. A. Williams, "SMEs' adoption of enterprise applications: A technology-organisation-environment model," *Journal of Small Business and Enterprise Development*, vol. 20, no. 4, pp. 735–753, Oct. 2013.

[8] L. Morgan and K. Conboy, "Factors affecting the adoption of cloud computing: an exploratory study," 2013.

[9] L. Morgan and K. Conboy, "Key Factors Impacting Cloud Computing Adoption," *Computer*, vol. 46, no. 10, pp. 97–99, 2013.

[10] N. Alkhater, G. Wills, and R. Walters, "Factors Affecting an Organisation's Decision to Adopt Cloud Services in Saudi Arabia," in *2015 3rd International Conference on Future Internet of Things and Cloud (FiCloud)*, 2015, pp. 553–557.

[11] S. S. Nawaz and S. Gunapalan, "Evaluating the Adoption of Enterprise Applications by Small and Medium Enterprises in Sri Lanka," *European Journal of Business and Management*, vol. 7, no. 4, pp. 324–334, Mar. 2015.

[12] Fariba Safari, Narges Safari, and Alireza Hasanzadeh, "The adoption of software-as-a-service (SaaS): ranking the determinants," *Journal of Ent Info Management*, vol. 28, no. 3, pp. 400–422, Mar. 2015.

[13] S. Das and M. Dayal, "Exploring determinants of cloud-based enterprise resource planning (ERP) selection and adoption: A qualitative study in the Indian education sector," *Journal of Information Technology Case and Application Research*, vol. 18, no. 1, pp. 11–36, Mar. 2016.

[14] G. Ercolani, "Análisis del potencial del cloud computing para las PYMES: un modelo integrado para evaluar software as a service (SaaS) en la nube pública," Universidad de Murcia, Murcia, 2017.

[15] W. Sun, X. Zhang, C. J. Guo, P. Sun, and H. Su, "Software as a Service: Configuration and Customization Perspectives," in *IEEE Congress on Services Part II, 2008. SERVICES-2*, 2008, pp. 18–25.

[16] C.-P. Bezemer and A. Zaidman, "Multi-tenant SaaS applications: maintenance dream or nightmare?," in *Proceedings of the Joint ERCIM Workshop on Software Evolution (EVOL) and International Workshop on Principles of Software Evolution (IWPSE)*, New York, NY, USA, 2010, pp. 88–92.

[17] Nitu, "Configurability in SaaS (software as a service) applications," in *Proceedings of the 2nd India software engineering conference*, New York, NY, USA, 2009, pp. 19–26.

[18] B. Martens, M. Walterbusch, and F. Teuteberg, "Costing of Cloud Computing Services: A Total Cost of Ownership approach," in

Proceedings of the Annual Hawaii International Conference on System Sciences, 2012, pp. 1563–1572.

[19] F. D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, vol. 13, no. 3, pp. 319–340, 1989.

[20] W. J. Doll and G. Torkzadeh, "The Measurement of End-User Computing Satisfaction," *MIS Quarterly*, vol. 12, no. 2, pp. 259–274, 1988.

[21] S. Marston, Z. Li, S. Bandyopadhyay, J. Zhang, and A. Ghalsasi, "Cloud computing - The business perspective," *Decision Support Systems*, vol. 51, no. 1, pp. 176–189, 2011.

[22] G. Ercolani, "Análisis del potencial del Cloud Computing para la PYMES.," *Cuadernos de Gestión de Información.*, vol. 2, no. 1, pp. 40–55, 2012.

[23] G. Ercolani, "Cloud Computing Services Potential Analysis," presented at the CLOUD COMPUTING 2013, The Fourth International Conference on Cloud Computing, GRIDs, and Virtualization, Valencia, 2013, pp. 77–80.

[24] P. Géczy, N. Izumi, and K. Hasida, "Cloudsourcing: managing cloud adoption," *Global Journal of Business Research (GJBR)*, vol. 6, no. 2, pp. 57–70, Mar. 2012.

[25] J. A. Martilla and J. C. James, "Importance-Performance Analysis," *Journal of Marketing*, vol. 41, no. 1, pp. 77–79, 1977.

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