# Proposal of a Computer Supported Collaborative Work Model for E-Commerce Web Sites Based on a Quality Guiding Framework

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*Abstract*—**The exponential growth of e-commerce practices around the world is about to transform drastically traditional commerce by its infrastructure potential, the measurement of its intensity and its effects on the emergence of an information society. The study of the quality of e-commerce web sites is then prevalent; it is based on a review of literature in several fields: management, web-marketing, software engineering and Computer Supported Collaborative Work. The paper has a dual purpose, to propose at first a framework to guide the quality of e-commerce web sites and then to validate it by designing and developing a Computer Supported Collaborative Work. The framework was based on e-commerce web site's life cycle and Deming's wheel in addition to a quality measurement scale named e-ComDecaQual as it is in ten areas: ergonomics, features, content structure and information richness, compatibility, security, accessibility, referencing-positioning and e-reputation, adherence to regulations, compliance with standards, and sustainable development.**

*Keywords*-*e-commerce; quality; dimension; measurement scale; CSCW.*

## I. INTRODUCTION

The World Wide Web, being a giant of information and communication technology, allows millions of Internet users to engage in business transactions that literally transcribe reality and even surpass it by imposing new practices and by building creative horizons towards new uses and new business models. The United Nations Economic and Social Council [42] considers that Information and Communication Technologies (ICTs), characterized as universal technologies, have a great capacity to enhance development by increasing:

- Efficiency of economic and social processes;
- Efficiency of cooperation between different stakeholders;
- The volume and range of information available to individuals, businesses and governments.

In the e-commerce domain in particular, we are indeed witnessing a frenetic development of applications constantly enriched with new services, new forms of navigation, and new features of interfaces ranging from flash animations that apply quick-views, various zooms on product store, specialized research, price comparisons, virtual visits and virtual fitting by augmented reality. On certain sites, the user becomes "prosumer". "Prosumer" is a new marketing concept; it is a diminutive, shortcut and concatenation of two words producer and consumer [15]. Consumer becomes "prosumer" by participating in the design of his own product

or service as it is possible on "freeyourshirt" site [69]; the examples are multiple. The "prosumer" chooses his location, product, then the colour, the size, the picture or design or text to be printed on thus he becomes producer of his individualized product.

There is much material for the study of the quality of e-commerce web sites (E-CWS), which can play a major role in improving the turnover of e-commerce by increasing traffic. The quality of merchant sites can play a key role in attracting customers, gaining their trust and increasing their satisfaction, in retaining them and generating competitive success. We will therefore base the foundation of a framework using a measuring scale that emphasizes the quality of an E-CWS. This quality guidance framework would constitute an infrastructure of a Computer Supported for Cooperative Work (CSCW).

This paper is structured into six sections. In Section 2, the subject is framed in its context and explained by a set of questions. In Section 3, a review of the literature is exposed and dispatched on the specialties that gave serious consideration to the subject, namely management, software engineering, web-marketing scholars and practitioners. Section 4 gives a synthesis of literature and classifies quality domains to prepare Section 5, which is reserved for the design of quality guidance framework for e-commerce web sites. In Section 6, a validation aspect of quality guidance Framework is offered by Computer Supported Cooperative Work.

## II. GENERAL CONTEXT AND RESEARCH QUESTIONS

Several factors come into play to boost or to slow down the flowering rate of e-commerce and consequently economy. Among these factors we can cite the degree of adherence to technological progress, comprehensive requirement engineering for a project as E-CWS, legislation in force in a country, rigorous compliance with standards. Adopting a framework for enhancing E-CWS' quality must be considered as part of a quality strategy. During the resolution of this issue the study sought to respond these questions:

- How do companies that practice e-commerce guarantee their evolution and their sustainability despite their competitors?
- Are there precedent means for improving E-CWS' quality? What are the main guidelines or quality domains for E-CWS? How these domains are refined and how can they be measured?
- How do quality dimensions of E-CWS help satisfy the customer?

- How to prove and verify such a framework for E-CWS' quality?

As the study seeks to formalize a framework of quality for E-CWS, several examinations of theoretical foundations about quality were made as a review of literature in different domains such as in general management, in merchant web practices, in software engineering and in web technologies. The objective guided by a firm desire for a continuous improvement of quality is firstly to identify relevant dimensions and items of E-CWS' quality, in order to propose them a set of control tools. In a second step, by dispatching the quality control tools on the various jobs profiles, which intervene throughout the life cycle of E-CWS, we end up formalizing a quality framework for E-CWS. In a third step, because of an intensive collaborative work between team members, CSCW was checked to learn how it is possible to concretize the framework in it.

## III. LITERATURE REVIEW

According to John Ruskin, "*Quality is never an accident; it is always the result of an intelligent effort*" [70]. Considering that we are dealing with e-commerce quality we need to come back to former disciplines' contributions as management, web-marketing and software engineering. These ones will be introduced in following sub-sections.

### A. Quality in management

The quality has blossomed in the United States through the works of Shewart and Deming, but it has also flourished in Japan, and its pioneers are Ishikawa et al. [23][47]. Quality is a constantly evolving and predictive foundation closely linked to developments in the industrial sectors. It is marked by economic movements and the history of companies, in particular globalization and the gathering of international markets. It focuses on an ultimate goal of **customer satisfaction**, delivering quality products and services. The company must deploy a continuous quest to identify and define customer needs and expectations in order to improve itself, and improve the quality of its products and services. Giordano [25] defines quality as "the set of sensory and sensorial impressions, as well as clues that appeal and attract attention from the first glance, interpreted by the consumer as a promise of quality that gives him trust, and satisfies him during the use". Yu and his collaborators propose that perceived quality is a subjective judgment constructed in the mind of the user and it is him who determines its value [67].

According to the quality management researcher Ishikawa [47], it can only be defined in terms of whoever does it; for the worker: quality means "being proud of his work". For the manager of the company: quality means "the realization of the requested production". For the manager of the methods: "the quality is the respect of the specifications". For the marketing director: "quality is the best fit of the product to the expectations of the public". As maintained by Chikli [5], "Quality is not the only goal to hold a diploma or a certification, the aim is to improve the company continuously so that it is more in step with the demands of the market". Literature detects the addition of other terms, which are embedded to quality in order to imply various meanings: Quality inspection, quality control, quality insurance and total quality management. All the tools and means used to achieve a quality level must be replicated on all internal and external processes that contribute to the manufacturing of the product or the design of the service. In this way, if quality is the act of satisfying the customer, total quality concerns the whole company, with its environment relations.

This induces that quality has different views and it is oriented to satisfy customer. It concerns every worker and it must be replicated all over a firm's functions and aspects.

### B. Quality in software engineering

From a computer science perspective, according to Burdet [63], the quality of software raises the problem of confusion due to the overuse of the reference framework for a given specialty. This fact runs counter the achievement of satisfaction, which is the first quality challenge. Indeed, the programmer will be interested in the possibility of code reuse; the system engineer will be interested in the performance and the optimized use of resources; the maintenance specialist will more aim at the predisposition of the software to modification, improvement and evolution. "The ability of a set of intrinsic characteristics to meet requirements" is the definition that was adopted by ISO 9000 for quality software. It dismisses all subjective and personal vision; it reveals its strong link to demands or requirements engineering. Kano distinguishes between explicit and implicit or latent requirements [71]. The satisfaction levels of the clients are combined in the Kano diagram and are analysed in this way: The quality of software is therefore its ability to satisfy expressed but also tacit demands. The Kano diagram presented on an orthonormal frame includes a diagonal line that goes through the origin and represents the expressed functionalities; they are formulated by the client who feels more satisfied as they are more controlled. On the other hand, if the functionalities include any defect, they lead to a fall in proportional satisfaction. The Kano diagram [71] also includes two hyperbolas: the one at the bottom of the diagonal represents the obvious and basic functionality to talk first about product and neutral satisfaction. The smallest defect in these functions is disastrous (personal data security, payment security and product delivered not conforming to the representation on the site). The hyperbola at the top is that of the attractive and unpredictable features that are part of the provocation of the client's latent needs and the creation of expectations. With a minimum of these functions, the customer can be exalted. These are value-adding functions and an opportunity for innovation. This can be noticed in virtual testing interfaces on some E-CWS or in the interfaces completing the design of customizable products. Keeping up with a highly competitive conjecture, which includes taking possession of ICT implies that it is no longer worth to conform to the quality of the explicit requirements or the basic ones for software. One should rather look for attractive features to be distinguished.

Consistent with software engineering, it should also be pointed out that quality is governed by two model families, the models of certification and those of maturity and improvement [52]. As examples of the first family of models, we can quote the ISO 9000 certification, the France Telecom TQE and the DOD 2167A certification. In the second family whose purpose is to measure the ability of engineering company to develop and maintain quality software, we can enumerate the Software-Capability Maturity Model (SW-CMM), Trillium (from Bell Canada for Telecommunications) and the Software Process Improvement and Capability Determination (SPICE) project launched in 1993 with the objective of establishing a normative model for the evaluation of software development processes in the organizations concerned [52]. Without pretending to reach the scale of such projects that require great human and material investments, it is in the second family that we place our attempt to propose a framework and a CSCW to enhance E-CWS' quality.

### C. Quality according to Web-marketing scholars and practitioners

Several studies have been carried out to find domains that greatly influence the perceived quality of E-CWS. Parts of them have confirmed the importance of certain domains without constructing scales. Some other contributions have resulted in formal scales for measuring e-commerce service quality. Practically all the studies are based on the same research methodology: considering client satisfaction by making assumptions, formulating each hypothesis with a set of questions that can have qualitative and measurable answers according to Lickert scale. The hypothesis is used to verify the importance of an aspect of perceived quality. This would insinuate a quality dimension. The different questions that define a hypothesis transcribe some detail that corresponds to a quality item. Results of the questionnaires administered to a public of respondents lead to various statistical models confirming or invalidating hypotheses. They also yield indicators for the degree of correlation of quality items. The scale's coherence is high if the responses to the elements are correlated with each other and with the total score of the scale. The scale's coherence is doubtful if the scores of several elements are in contradiction with the total score. Researchers resort to calculate the Cronbach alpha as a method to estimate the internal coherence of their scales [17].

Among the recurring fixed hypotheses that led to quality dimensions and that can be named, we can mention the quality of design or ergonomics, information richness, reliability, ease of use, responsiveness, security, service, efficiency, privacy. Domains found in literature are organized separately based on whether they emanate from simple studies or from famous scales or further more if they are introduced by practitioners. In the following passages we list them in descending order of number of authors who cited them.

In studies that did not officialise scales, most quoted domain was quality of design, number of researchers

included it in their surveys [1][13][27][31][33]-[36][39][43][48][49][50][54][55][57].

Second, scholars dealt with variety and quality of information in their studies such as[1][12][13][27][29]-[31][34][36][43][48][49][54][55][57]. Security domain is in third place as well as reliability and reactivity. These scholars took security into account [12][13][27][31][34][39][43][48][49][54][57][64]. Then ease of use was quoted by [13][35]-[36][43][48][50][54][55][64][65]. A quality criterion called customization was evoked by [33][34][39][43][48][50][55]. Performance (or quoted by some ones efficiency) was cited by [13][31][39][46][54][56]. Privacy was quoted by [13][46][49][56]. We found also reputation quoted by [39][46][57][64][65]. Feeling quoted by [12][31][39][46][50][55].

Despite the fact that Paschaloudis's study [46] does not fall directly within the domain of e-commerce and even if it does not bring a new scale, we consider it for several reasons: It is a solid exploratory study based on the seven dimensions of the most famous scales. The study resulted in 487 valid responses on a volume of 800 questionnaires, a factor and correlation analysis followed by a series of regression analysis. Its interest lies in the fact of bringing back a double proof, one first proof confirming the reliability and consistency of the two scales mentioned above. One second proof confirms the strong and positive correlation between them and the perception of the quality of the banking sites and thus follows the possibility of their applicability and reusability in other fields.

To be complete, other to lesser degrees of citations were found in literature are quality of service, access, ease of contact, customer loyalty, interactivity, structure, trust, incitement, ease of ordering, ease of terms, ease of responding, speed of delivery, customer support, community for e-reputation, storage capacity, maintainability and web store policies.

As came first, the study was also extensively interested in proper quality scales. The scale **Webqual**$^{TM}$ proposed by Loiacono [37][38] is in 12 domains : (1) accommodation of information to the task, (2) trust, (3) response time, (4) attractiveness of design, (5) intuitiveness, (6) visual attraction, (7) creativity, (8) empathy, (9) integrated communication, (10) interactivity, (11) business process and (12) availability. **SiteQual** accredited by Yoo [66], has 4 domains (1) ease of use of the site, (2) site design, (3) speed of the order process and (4) security. **WebQual** scale belongs to Barnes [7] and contains 3 quality domains (1) quality of interactivity and service (trust, empathy), (2) site usability (design), (3) quality of the information presented on the site.

**PIRQUAL** of Francis [24] encloses 6 quality domains (1) online store features, (2) design of the product sheet, (3) conditions of sale, (4) conformity of delivered products, (5) customer service, (6) security.

**e-ServQual** the most famous and former scale coined by Zeithaml [68]and Parasuraman [44] as cited by Buttle [11] is based on 11 domains : (1) reliability, (2) liability, (3) access, (4) flexibility, (5) navigational facility, (6)

efficiency, (7) insurance / trust, (8) security, (9) knowledge of prices, (10) aesthetics, (11) customization. **eTailQscale** is the work of Wolfinbarger [62] based on 4 domains (1) reliability and compliance with commitments, (2) site design, (3) security / privacy, (4) services provided to consumers. **E-S-QUAL and E-RES-QUAL** is a double scale considered as the most famous scale set up by Parasuraman [45], **E-S-QUAL** contains (1) efficiency of the site, (2) compliance with commitments, (3) system availability, (4) respect for the privacy of users and **E-RES-QUAL** contains (1) reactivity, (2) compensation and (3) contact.

**NetQu@l** conceived by Bressolles in 2006 [10], is composed by (1) quality and quantity of the information presented on the site, (2) ease of use of the site, (3) design or the graphic style of the site, (4) reliability and compliance, (5) security and privacy of personal data, (6) offer proposed on the site, (7) interactivity and customization. **eTransQual** formalized by Bauer and co-authors [8] who recognize that a quality scale should integrate functional elements and hedonic ones. Their scale accommodates (1) features and design, (2) enjoyment (Pleasure), (3) business process, (4) reliability and (5) reactivity (responsiveness). **PeSQ** is the measurement tool of Cristobal [16] who analysed seriously what leads to user satisfaction levels? And what leads to loyalty? It is based on (1) website design, (2) customer service, (3) insurance and order management. The scale **E-SELFQUAL** proposed by Ding [18] was refined in 4 domains so thus: (1) Perceived control: you know what to expect in following steps, you know how long it takes to complete the transaction, and you know information will be provided in each page. (2) Service convenience: convenience for registration, convenience for changing items in the basket, convenience to update your order. (3) Customer service: customer service is easy to access, customer service is responsive, and customer service shows a sincere interest in solving problems. (4) Service fulfilment: you get what you ordered, the order is delivered as promised, the final price reflects the true value, and the product was presented accurately on the site.

### D. Quality according to practitioners

Some other quality criteria were gathered from practitioners' experience. According to Malassingne [40], web quality is the best way to produce content and web services. This encompasses the end result, but also the way to do it. It is determined on the basis of identified objectives, which make it possible to orient the choices and to measure the continuous improvement with regard to these objectives. The web quality is managed using all the disciplines of the web pages' design and realization. The set is to ensure the best possible user experience while optimizing the realization processes [40]. The same reference quoted Lafon who started from the definition of the web's god-father Tim Berners Lee: "Put the Web and its services at the disposal of all individuals, whatever their hardware or software, their network infrastructure, their native tongue, their culture, their geographical location, or

their physical or mental abilities". Lafon quickly realized that what comes out of the Tim Berners Lee's definition is the importance of practicing web quality. In its approach, it fits perfectly with the precursors, those of the management field: To deploy quality measures on all the professions of the web useful during the process of any website's design and construction. Lafon bases his method on seven quality domains: (1) compliance with standards, (2) accessibility, (3) performance, (4) security, (5) functionalities (or features), (6) ergonomics and (7) referencing [40].

Sloïm, a purely quality control manager defines web quality as "The ability of an online service to meet implicit or explicit requirements". He emphasizes the difference between Web Quality and Web Quality Management. The latter is a "Set of coordinated activities whose objective is to evaluate, improve and guarantee web quality" [40].

The same reference talked about Taillandier who dealt with W3C standards and accessibility in the digital world to achieve quality. He gives this definition: "Quality is pre-eminently an ideal to be achieved and not an end in itself" [40]. The challenge is to arrive at taking into account and to cohabit for the best all disciplines supposed to intervene in a modern web production chain – (1) user experience, (2) information architecture, (3) ergonomics, accessibility, (4) web design, (5) performance, (6) mobility, and (7) security – all of them according to the project specific constraints. In conformity with Google's guidelines, there are seven high-quality criteria [4]: (1) the site must have good content, (2) no technical error, (3) positive reputation, (4) website must reveal reliability, high level of expertise in addition to some authority, (5) site must rotate design around its features, (6) the site must provide useful information about the site, and (7) the site must offer sufficient quantities of relevant and satisfactory information.

### IV. SYNTHESIS OF LITERATURE AND CLASSIFICATION OF QUALITY DOMAINS

As outcomes of literature review, many apprenticeships are won: Quality is a continuing occupation and labour. Quality Management is a set of coordinated activities whose objective is to evaluate, improve and guarantee web quality. Quality must be considered according to the job profile. Quality must be deployed in minute details of domains. E-CWS must rotate design around its features. Great control of programming technologies allows offering expressed and attractive features. Nearly thirty domains have been identified, a great part of them are dealing with customer relationship and customer satisfaction that should be transposed on web sites by features.

Every domain contains a set of items. In an effort to draw up an almost exhaustive list of quality domains, terminology has been first brought closer and unified. Table 1 shows a decreasing classification of quality domains in terms of citation in the literature and according to practitioners' recommendations.

TABLE I.  QUALITY DOMAINS' RATE ACCORDING TO SCHOLARS AND PRACTITIONERS

| Quality Domain and its rank | Rate | Quality Domain and its rank | Rate | Quality Domain and its rank | Rate |
|---|---|---|---|---|---|
| **1**- Design /Ergonomics | 26 | **11**-Privacy | 7 | **21**-Maintainability | 2.5 |
| **2**- Information variety | 22 | **12**-Access | 6.5 | **22**-Customer support | 2 |
| **3**- Reliability | 17 | **13**-Insurance | 5.33 | **23**-Customer loyalty/Fidelity | 2 |
| **4**-Security | 17 | **14**-Feeling | 4.5 | **24**-Incitement | 2 |
| **5**- Ease of use | 16 | **15**-Trust | 4.16 | **25**-Ease of terms | 1 |
| **6**- Reactivity | 14.33 | **16**- Ease of ordering | 4 | 26-Ease of responding | 1 |
| **7**- Service quality | 12.33 | **17**-Structure | 3.5 | **27**-Speed of delivery | 1 |
| **8**- Performance/Efficiency | 11.5 | **18**-Interactivity | 3 | **28**-Community for e-reputation | 1 |
| **9**- Reputation | 10.33 | **19**-Web store policies | 3 | **29**-Storage capacity | 1 |
| **10**- Customization | 9 | **20**- Ease of contact | 2.5 | **30**-Low prices | 0 |

## V. DESIGN OF QUALITY GUIDANCE FRAMEWORK FOR E-COMMERCE WEB SITES

In the development of a quality framework for E-CWS, steps that were followed are described in these sub-sections.

### A. Research methodology

The quality of a diagnosis depends on the model's quality; the model describes the organization's vital aspects [19]. In order to design a model for quality guidance framework, an ad-hoc approach was adopted. It is described as follows:

*1)  Step 1 Gathering domains and items*
- Collect the maximum of E-CWS' quality domains cited by scholars and some practitioners.
- Collect items for each domain.
- Move certain domains closer and unify them as they have common sense, 30 domains were retained. Prepare a matrix: with authors on lines and quality domains on columns.
- Add a mark at the crossing if the author talks about the quality domain in his study.
- Sum marks for each quality domain to calculate relevance degree for a given quality domain according to literature.
- Sort totals by domains as shows Table 1

Three separate matrixes have been produced, depending on whether the work proceeds from exploratory studies by researchers (Researchers' domains) or whether they are quality measurement instruments formalized on formal scales (Researchers' formal scales) or from the recommendations of practitioners (Practitioner domains). The overall frequency of each of the thirty domains was calculated, sorted and combined in Table 1.

*2)  Step 2 Structuring domains in a scale*
- Highlight the best domains that meet certain conditions: those that occupy the best ranks, those that correspond to the criteria of software quality according to software engineering, those for which

we are able to find control tools and those that are easily placed on E-CWS' life cycle. Indeed, what we are interested in, are domains that are currently possible to control by tools and those completely under the control of the team members (designers, developers, salesmen and web-marketers).
- Structure domains with low rates as sub-domains or domain items of high domains as depicted in Figure 1.
- As a first outcome we selected the seven first domains as follows: Ergonomics, i.e., Design, Features, Content structure and Information Richness, Security, Compatibility, Accessibility and Referencing SEO e-reputation.

*3)  Step 3  Enriching the scale*
- As a contribution, three domains were added. They were not sufficiently dealt with until then, but they were actually with imminent importance in e-commerce field according to a number of scholars:
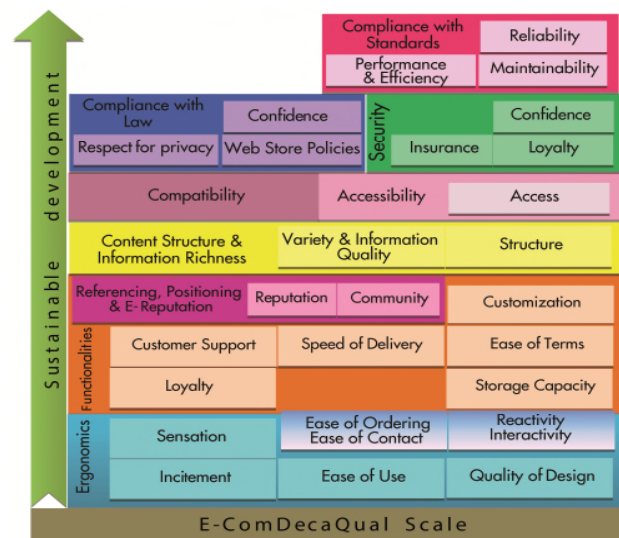


Figure 1. E-ComDecaQual Scale Composition.

E-commerce regulation [6][32][53], Respect of standards [3][26][60] and Sustainable development[9][14][20].

- Establishing a new quality scale based on ten domains hence the name E-ComDecaQual Figure 1.

*4) Step 4 Associating control tools to job profiles*

- Search for tools and test them to control the quality of domains' items.
- Assign one or more quality domain to one or more job profiles.
- Locate quality domains on E-CWS life cycle as a first view of the framework, see Figure2.

E-CWS's quality is quality perceived by the customer. Thus, it mainly revolves around the customer's satisfaction. To reach customer's satisfaction, we concentrate on all job profiles that intervene and operate during E-CWS's life cycle from its birth as a project until its decline. The process of designing, developing and exploiting an E-CWS is no more than conducting its life cycle while arranging, combining and calculating sequential and parallel steps with various profiles of jobs. In the schematic representation of this point of view, we distribute the quality domains of e-ComDecaQual scale on different stages. The role of this framework view is to highlight job profiles and to ensure staff satisfaction according to quality's predecessors; the managers.

*5) Step 5 Integration in PDCA wheel*

- Distribute quality domains on Deming's PDCA wheel as another view of the framework and to emphasize the continuous and evolving quality undertaking as shows Figure 3.

Being aware that improvement must be continuous to strengthen the efficiency of any project [63], the quality guidance framework was built around the PDCA model of Deming and then map the E-CWS life cycle on it. Deming distinguishes three types of quality [2]:

The quality of the design / redesign: it begins from the expression of consumer needs and prototyping. That's what we planned in the Act of the first round of the wheel Figure 3. The company must adopt the predictive attitude and have a long-term vision of the needs and behaviours of consumers. It also must continuously operate adaptations of production and the commercial apparatus, that's what we planned for further rounds of the wheel.

Compliance quality is measured by the company's ability to conform to and then to exceed the basic product specifications. It is based on a managerial and organizational willpower that leads all processes involved in delivering the product / service to do so with a zero-defect goal. These are possible due to regular turns of the wheel and aiming for attractive features, see Figure3.

Quality of performance: it observes, through sales analysis, how the product is perceived on the market and perceives the use that the customer makes. It is through use that his consciously expressed and unconscious expectations are revealed. The quality of performance will influence the quality of re-design to spin the wheel of continuous

improvement [2]. That's what we expressed by the e-commerce life cycle and implication of all actors.
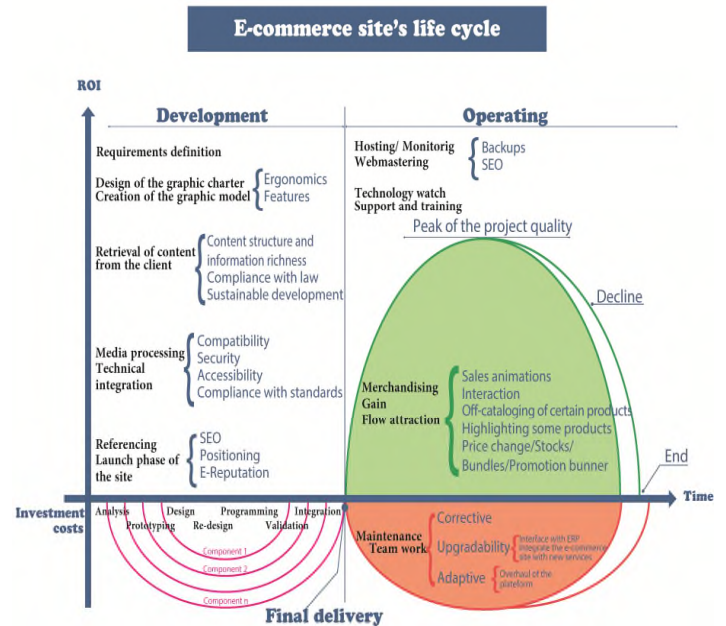


Figure 2. E-commerce Site's Life Cycle and Quality Domains.

*B. A model abstraction for e-ComDecaQual*

An overview of the semantics described throughout this study is now possible by an object data model. UML allows practicing an abstraction of the static vision for the quality guidance framework and its e-ComDecaQual scale by means of a class diagram, see Figure 4. The domains class is at the moment instantiated to the **ten domains** identified in the **e-ComDecaQual** scale, but it is scalable and dynamic to accommodate other domains with their possible structuring items and tools since the E-CWS are in perpetual relationship with technological progress. The tracking of including a quality domain is taken into account by monitoring the publications, dates and authors who brought back the proof and the demonstration in the manner of the present study. The domains class is in full aggregation with itself to present the possibility that a domain could be divided into sub-domains for a better dispatching of items and their measurement tools like ergonomics, which allow studying behavioural and structural sub-domains. The functional domain is also subdivided into common or standard functionalities, e-commerce functionalities and collaborative or community functionalities [59].

Sub-domains can have a different meaning, which is rather a technical structuring such as user tests, statistical analysis and eye-traking [59]. Each domain or sub-domain is a collection of items. The model even allows multi domain patterns (structuration or imbrication). Most items are measurable by tools. Tools are known to be specialised in one domain. E-commerce compliance with law and sustainability do not have classic control tools at present, they are related to datamining tools. As dealt with in the Deming's wheel, in Figure 3, E-CWS are inventoried and
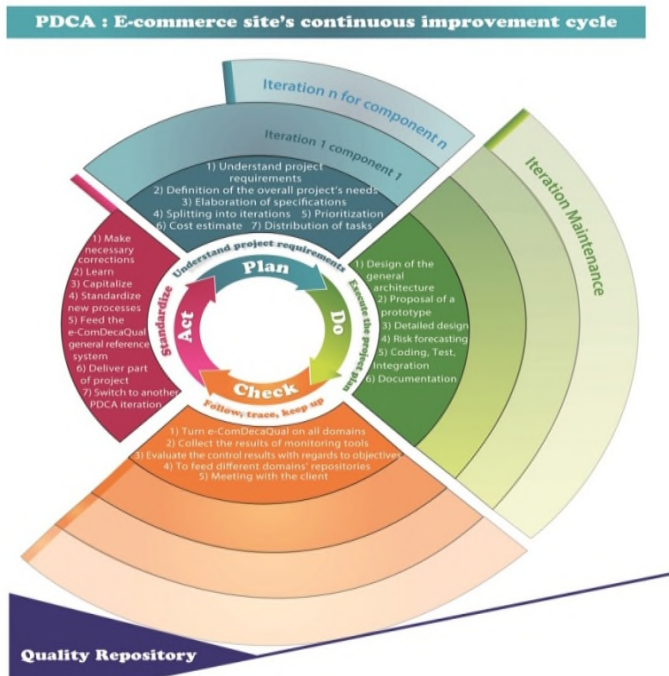
Figure 3. PDCA Cycle of Continuous Improvement of an e-Commerce Web Site.

they are subject to periodic quality control by a tool that measures the quality of items' set, therefore of a particular domain or sub-domain. The control is requested by a member of the team specialized in a domain, it could be a content editor, a developer or integrator, a web designer or computer graphics designer. The quality project manager or the administrator coordinates their jobs. A tool naturally returns a comprehensible report deciphered for a domain specialist. The report is taken into account for the Check and the Act. The report is recorded and archived in the domain quality repository.

The inheritance between the team member and the quality administrator designates that the population concerned is entirely either team members or quality administrator and that a member could combine two different roles, which is in general the case of the project manager who may have another specialty. Quality tools are selected and proposed by the specialists of a domain. A team member chooses to control E-CWS domain quality from this validated set of tools. The quality reports are ordered and dated; the PDCA wheel runs continuously.

## VI. VALIDATION OF QUALITY GUIDANCE FRAMEWORK BY A COMPUTER SUPPORTED COLLABORATIVE WORK

As a guidance framework named e-ComDecaQual to foster the quality of E-CWS based on two axes and a measurement scale was specified in a first part of the present study, it made it possible to ascertain that it is closely related to domains specialities, but with great regard, it was also recognized that quality implicates a high collaboration, cooperation, coordination and communication between group of actors working together around an e-

commerce project, e.g., various reports monitoring tools often address several domains for instance ergonomic tools, features, content structure and information richness – Thus the second part of the study is to validate the earlier specified quality guidance framework by adapting a CSCW.

In the following section, conceptual specification based on computer-based technologies is presented from two points of view, from 3C specification (Collaboration, Cooperation, and Communication) and then from functional specification to give finally an overall view.

### A. Preliminary

At present it is a clear fact that among most visited websites, we find social networks as Facebook and Google Hangout, collaborative document editors as Google docs, online games, which are part of collaborative applications. According to Teruel et al. [58], there is a collaborative trend for modern software nevertheless, despite the possibility to adopt exhaustive methodologies to design them, these methodologies have a great deficiency, and they do not seriously treat Requirement Engineering stage. This lack comes from the complexity of dispatching user requirements on CSCW's conventional tasks (3C: Collaborating, Cooperating, and Communicating), which in turn is subject to the degree of users' awareness [58]. Consequently, to avoid these weaknesses, a special consideration will be taken while designing e-ComDecaQual's CSCW. Before that, there is a need to clarify the ambiguity between groupware and CSCW.

By focusing on how computer networking technologies can support collaborative control quality activities, great polemic was felt to firmly settle on a similar or a distinguished definition for CSCW and groupware. According to Whitaker [61], it is in 1984 that Greif and Cashman coined the label Computer-Supported Cooperative Work (CSCW) as a marketing tag for a vision of integrated office IT support. He also presents the first definition introduced by Bannon and Schmidt in 1989 [61]: "...*A shorthand way of referring to a set of concerns about supporting multiple individuals working together with computer systems*". But the definition of Eseryel et al. [22] seems to be more close to context of quality: "*CSCW systems are collaborative environments that support dispersed working groups so as to improve quality and productivity*".

CSCW is also known as a multi-disciplinary research field bearing upon tools, techniques, task orientation and workflows that are networked and/or distributed. It is belonging to an emergent phenomenon that deals with Technological Support for Work Group Collaboration, Collaborative Systems, Workgroup Computing, Group Decision Support Systems (GDSS), Interpersonal Computing, Augmented Knowledge Workshops, Coordination Technology, Computer-Assisted Communications (CAC), Computer-Mediated Communication (CMC) and Flexible Interactive Technolo-
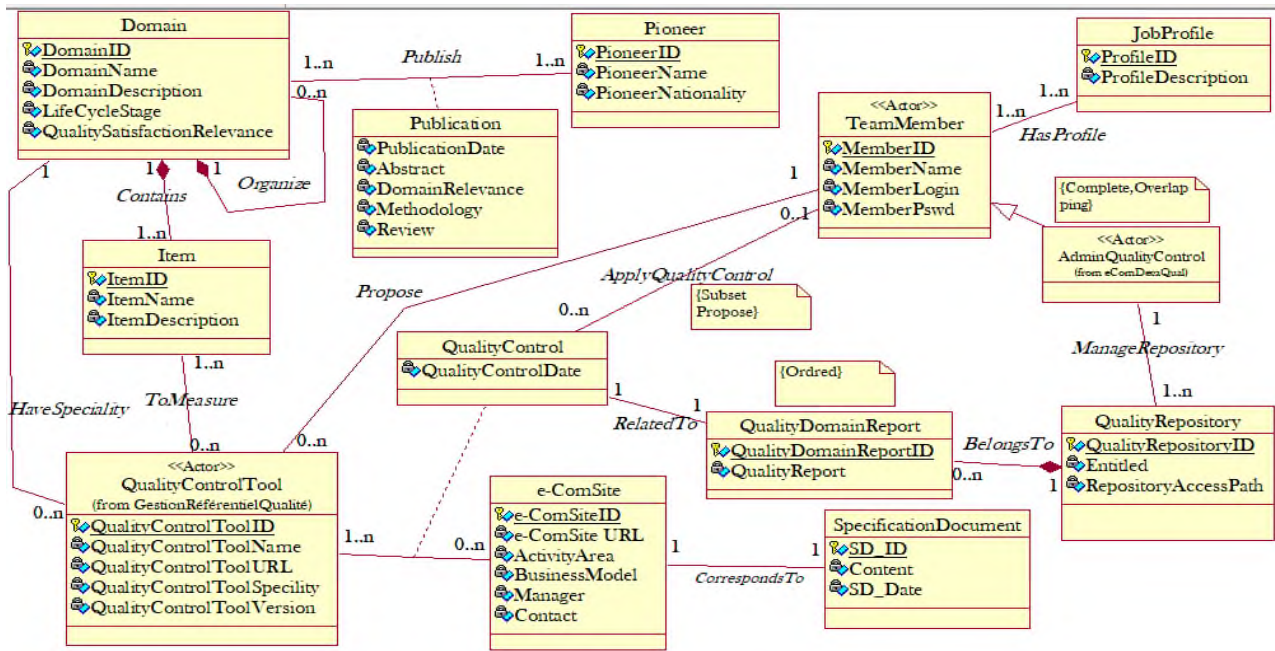
Figure 4. e-ComDecaQual Framework Abstraction by a Class Diagram.

gies for Multi-Person Tasks. According to Whitaker too [61], in 1978 the word Groupware was conceived by Johnson-Lenz and Johnson-Lenz to mean:" *Intentional **GROUP** processes and procedures to achieve specific purposes plus soft**WARE** tools designed to support and facilitate the group's work*".

"*A groupware makes the user aware that he is part of a group, while most other software seeks to hide and protect users from each other ... Groupware ... is software that accentuates the multiple user environment, coordinating and orchestrating things so that users can "see" each other, yet do not conflict with each other*", a definition of Kevin J. Lynch brought back by Griffiths [51].

At the end, we are perfectly at ease with claiming that groupware refers to computer-based systems to assist interacting groups whereas Computer Supported Cooperative Work (CSCW) focuses on the study of how groups work and how implement technology to boost their interaction and collaboration in addition to studying their psychological, social, and organizational effects [21][41].

### B. Collaboration, Cooperation, and Communication (3C) specification of e-ComDecaQual's CSCW

Dealing with CSCW implies several kinds of interactions: Collaboration, Cooperation, Coordination, Contribution, and Communication. For each one, there is a battery of supporting tools and techniques such as e-mails, discussion forums, chat-rooms, videoconferences, and posts announcements for communication. Distributed learning environment besides web-based tool kit, facilitate the sharing, and organization of ideas for collaboration. Control access to different documents, granting rights and prioritization for coordination and control is also made possible.

The collaborative and cooperative approaches can be considered as two poles rather than two distinct apprehensions; one evolves from cooperation to collaboration. In order to grasp their differences, it is necessary to observe the nuances relating to the autonomy and the degree of control as well as the means used to achieve the goal and to carry out the task and to clearly differentiate the level of interdependency between the participants.

Cooperative and collaborative groups work towards a common or shared goal. It is in the way of sharing work that difference is most visible. Indeed, the way to achieve the goal through cooperation is based on the distribution of tasks and responsibilities within the group to achieve the goal cooperatively. This corresponds to the nature of work to lead an e-commerce website project in its entirety and in full respect of its life cycle.

On the other hand collaboration requires individual responsibility to achieve the goal, which corresponds to the intrinsic responsibility of a specialist member of one domain of the e-ComDecaQual scale: Member or team of graphic designer, member or group of developers, member or group of marketers etc. In the way of carrying out common task, there are other dependencies: The maturity of groups, interactions between members and the way every one considers the goal [28].

Collaboration implies a shared vision of a very high level with a derisory importance for the division of tasks. On the other hand, coordination requires a high control level of the subdivisions of the tasks with moderate look for a shared vision. Cooperation is between the two.

The ability to collaborate involves a gradual prior appropriation of other abilities, such as cooperation, coordination, contribution and communication.

The model of the e-ComDecaQual scale with the PDCA axis has clearly emphasized the involvement of a member specialized in a domain. This detail is made explicit in Figure 5 and its legend in Table 2.

### C. Functional specification of e-ComDecaQual's CSCW

The proposal for quality guiding framework of E-CWS' is being concretized and validates by developing a CSCW structured around ten domains scale named e-ComDecaQual and which offers a range of tools broken down according to the items of each domain. Some tools can be measuring instruments for several domains. Domains as well as their tools are specific to the various job profiles of the team around the E-CWS. The CSCW allows creation of domains, their possible structuring in sub-domains and the arrangement of items in various domains / sub-domains. It allows assignment of tools to check items. CSCW allows registration of team members and their association to job profiles.
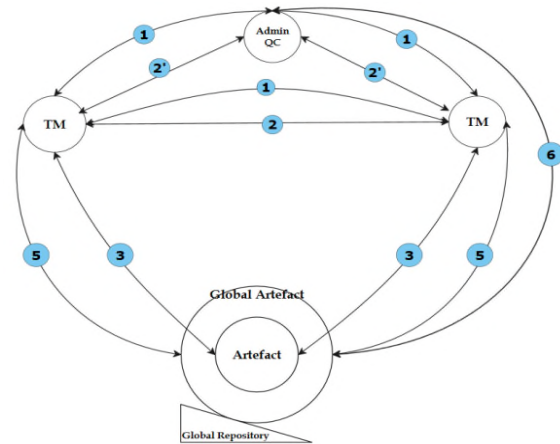


Figure 5. 3C Network of e-ComDecaQual's CSCW

TABLE II. 3C SPECIFICATION OF E-COMDECAQUAL'S CSCW

| Legend | | | |
|---|---|---|---|
| **Admin QC** | Quality Control Administrator /Project Manager | **2** | 2- Direct communication between team member with the same profile: Computer-Mediated communication (CMC) |
| **TM** | A Team Member : can have different or same speciality with another TM | **2'** | 2'- Coordinate |
| **Art** | Art: Artefact of work of domain and its items | **3** | 3- Collaboration: Working using platforms, APIs, languages, design tools, frameworks etc… |
| **GA** | Global Artefact | **4** | 4- Control quality with dedicated tools, retrieving control report and feedback with shared work objects (versioning Domain quality report) (feedback mistakes weaknesses and warnings) |
| **QDR** | QDR: Quality Domain Repository. To be verified | **5** | 5- Cooperate |
| **GR** | GR: Global Repository: to be verified and to feed through for communication of awareness. | **6** | 6- Knowledge management by gathering and collecting final quality control reports to constitute the Global Repository |
| **1** | 1- Understanding: meeting and decision support systems for common understanding | | |

It allows collaborative work between them supervised by a Quality Control Administrator who could have the function of project manager. Team members exchange messages with the administrator and receive notifications.

The E-CWS either under construction, or operating, are registered by their URLs and their specifications or user requirements (Plan) in order to ensure their quality control by rotating (Do) each time a quality domain controlling tool and by getting back a report (Check). As an e-commerce web site advances his life cycle, a domain or sub-domain is monitored. E-ComDecaQual groupware centralizes the reports in a repository by allowing their versioning (Act). The repository is a capitalization of know-how in the various quality domains and an experience accumulation of all domains.

The CSCW functional aspects are represented according to the formalism of UML's Use Case Diagram (UCD).Figure 6(a) shows the overall functionality supported by the groupware and offered to the main actor: The Quality Control Manager or Administrator. Figure 6(b) shows the functional aspects permitted for any job profile carried out by any team member. It is naturally allowed for the administrator. Figure 6(c) details the features related to

quality reports management and related to the global repository for e-commerce web site, which leads to the accumulation of domains know-how. Figure 6(d) shows what is involved in managing the e-ComDecaQual quality repository framework.

An overall view of the work is conjugated in Figure7; it shows the goals of the research, it recalls the quality guidance framework stand on two axes (life cycle and PDCA cycle) and a scale, it summarizes the details of the measurement tool e-ComDecaQual based on ten quality domains, and it evokes the most important kind of interactions between actors.

### VII. CONCLUSION

Although e-commerce web sites' quality is progressively attracting researchers' attention, existing scientific literature is mainly focused on identifying quality dimensions from Internet users' viewpoint. This has not been taken in a comprehensive approach taking into account the work force around it. It pays no deep attention to total quality management for an E-CWS. It therefore did not focus on quality domain constituents' census and their structuring, no longer on the identification of instruments and tools for

quality measurement and control. Almost all studies are based on working hypotheses and surveys to produce mathematical and statistical models without proposing any quality approach. This work attempted to fill the gap by proposing a quality guiding framework based on a model and axes. One axis was to dispatch quality domains on E-CWS's life cycle, another axis for continuous quality by Deming's wheel in addition to a measurement scale named e-ComDecaQual. The quality guidance framework was after that, validated by conceiving a CSCW. Immediate work requires the development of a detailed CSCW architecture,

but the research has established the basis for a number of other future works, such as proving the scale e-ComDecaQual by an exploratory study on a representative sample. Managing the quality repository leads first to an aspect of knowledge management that can enrich the functionality of the CSCW. The repository requires a serious work on formatting, unifying and aggregating quality tool reports. The study also opens the opportunity for further refinements such as proposing quality Frameworks and CSCW for other e-commerce business models such as B2B, e-Gov and intermediation models.
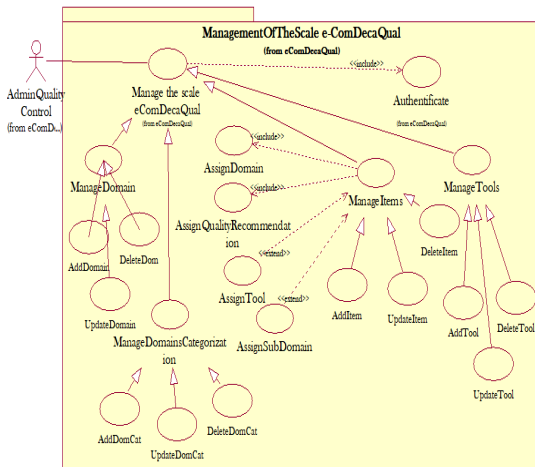
(a) Use Case Diagram e-ComDecaQual Groupware System Overview.
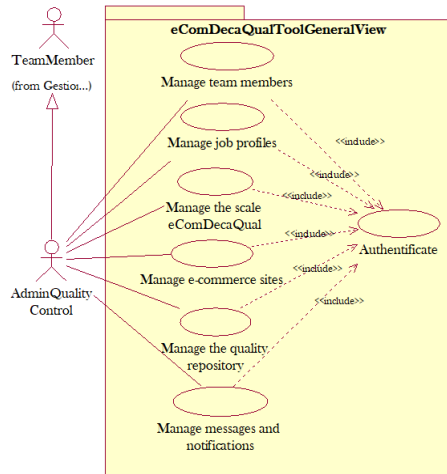
(b) Use Case Diagram Work of a Member with a Job Profile
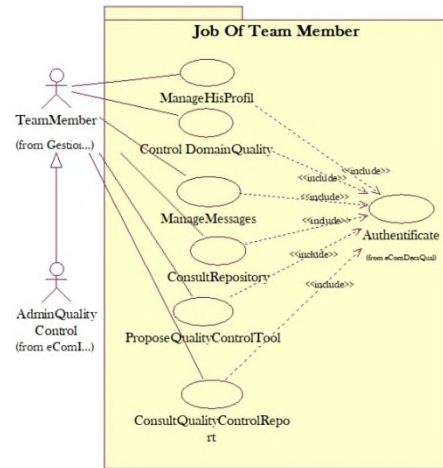
(c) Use Case Diagram Management of e-ComDecaQual scale.

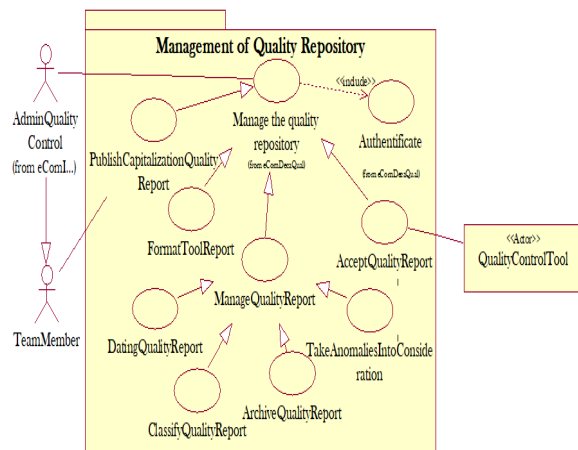(d) Use Case Diagram Management of the Quality Repository



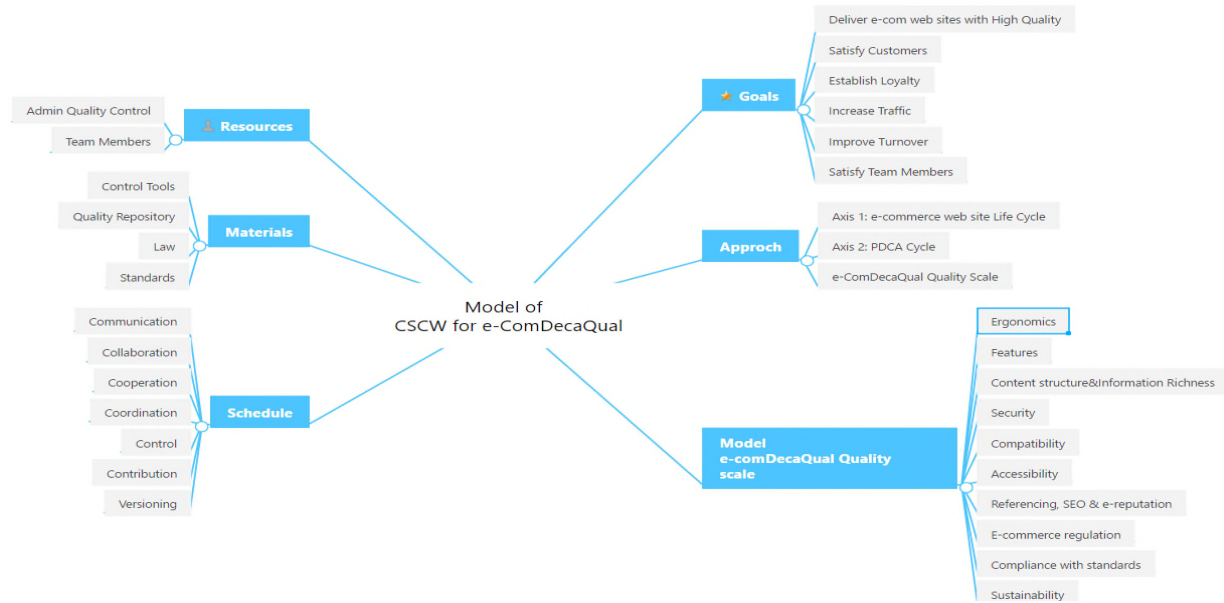Figure 6. Functional Specification of e-ComDecaQual's CSCW.

Figure 7. CSCW Model for E-Commerce Web Sites Based on Quality Guiding Framework

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