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Trust framework for online products and services using grain level comparison: A solution to bootstrapping problem

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ABSTRACT

Service-oriented architecture has changed the way that web applications are designed. Today users are more inclined towards online products and services to save time, energy, and cost. However existing frameworks for online purchasing have certain drawbacks and one of the foremost is 'trust'. Hence the struggle is to build such a system trust that offers commendations to the customer for the products and services even with inadequate resources; consequently building customer's trust upon the vender as well as the system. Current systems available only utilize trust by providing product features and comparison using the rating system. However, a problem occurs when a "Bootstrapping issue" is raised, i.e., if a new company emerges in the market then the existing system cannot generate a trust rating for it; the same goes for the new product. Such a problem can cause an uncertain situation for the customer to; a) whether go for the existing product or b) the new product of a new company. In this article, we propose a system trust using a novel framework, which can solve the problem of bootstrapping using a 'grain level approach'. By providing a high level of granularity, the details of the product's specs and features will be much in-depth, which will offer the customer an enhanced platform to examine and compare the product amongst several other similar products and ultimately coming to a decision to purchase it by trusting it. As a result, the decision-making power of the customers will be strengthened and the system's trust will be extended.

Keywords:

System trust
Bootstrapping
Rating systems
Granularity

1. INTRODUCTION

Numerous well-known companies and businesses went online to grow their market and potential profits. It has not only increased their revenue by saving the space used in physical stores (rental or owned), but also for the reason that customers find it to be more convenient. Online shopping enables customers to browse thousands of alternative products in a short period of time, viewing them anywhere; anytime at cheaper prices. However, this seems almost like a perfect way for shopping except that this method has some drawbacks. Trust is one of them. Trusting online systems and the sellers/retailers as well are the main issues currently that are preventing users from conducting purchasing online.

As described by [1], "*Trust is broadly acknowledged as a noteworthy part of human social connections. As a rule, trust is a measure of certainty that a substance will carry on in a normal way, in spite of the absence of capacity to screen or control nature in which it works.*"

The emphasis discussed in this article is to trust the product or service along with the provider, both the existing ones in the market and more particularly the new ones emerging. Precisely determining the evaluation criteria; that should be used upon online products/services and providers to indicate that a particular one can be trusted or not.



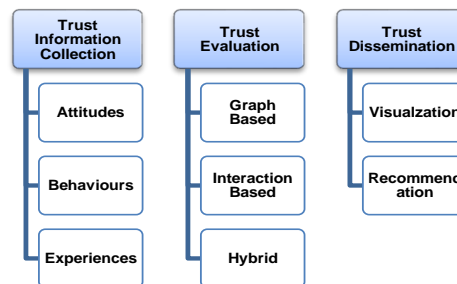


Figure 1. Building a social trust system - classification. [2]

Sherchan et al., mentioned how the trust information is collected by behaviors, attitudes and user experiences as explained in figure 1. It also shows in order to earn user trust, the system should get positive feedback and recommendations from the users that will help generate user trust for not only the product but also for the company as well [2].

Furthermore; to evaluate quality of service, the foremost check is trust. And to gain complete customer satisfactions, the quality of the product; the quality of the service and trust upon the product and trust upon the provider has become a huge factor.

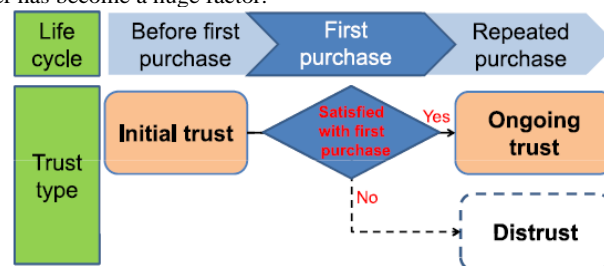


Figure 2. Trust Lifecycle. [3]

Also mentioned in figure 2, the trust lifecycle as to initial trust before the first purchase can trigger numerous repeated purchases once the ongoing trust is achieved [3, 4].

With the abundance of new products offered by the new providers and/or the same existing providers have led to some stern challenges:

- 1). to trust which product
- 2). to a trust whose service
- 3). to trust which provider

This dilemma leads to "Trust as a Service".

Current research indicates that trust can be used as a service for online purchasing not only for products and services but also for the vendors or companies as well. Furthermore, trust becomes essential for the boot strapping issue as a new company is emerging in the market and it needs to create an impact on the customer to increase its sale. The proposed 'system trust' provides a solution to the boot strapping issue by offering the grain level comparison approach, which provides the customer sufficient trust to purchase a new product online by trusting upon the new company.

1.1. Significance

System trust signifies the impact of high quality products and services. It also changes the dimension for online purchasing assessments through providing supporting benchmarks which can be set and calculated even for a new product. This makes the old systems redundant when it comes to new product whereas the proposed system trust becomes an adhoc system flexible enough to generate rating for not only an existing product but a new one as well.

Furthermore, previous models were aimed at the existing products/services only and ignored a major issue arose in the form of bootstrapping. So our focus becomes providing such a solution which addresses multiple issues including trust benchmark, bootstrapping and rater's credibility. By resolving these issues will not only provide trust benchmark for the customers for any product or services but also it will create awareness among online shoppers to trust which product and more importantly which vendor.

The results of the proposed system will provide a framework for propagating trust in service compositions as well as in product selection and trust in providers consequently helping the users to uplift their decision making powers.

2. Problem Statement

Easiness and constant availability of the internet have provided a great opportunity for service providers and vendors to enter the global market online. Therefore, it has enabled consumers to search for products from various providers, this means that customers surly going to browse at least one unknown/new provider. More likely this customer is not going to purchase from that particular provider unless they find it to be trustworthy and legitimate. Frequently, this will be based on the provider's reputation that comes from other users' previous experiences, feedback and rating. This raises a barrier between the customers and those new entrants/providers that still have not associated with customers yet but still have the criteria that any purchaser would seek in the purchasing process. In addition, the same problem occurs for the new products, from new providers, and from the existing providers. This issue is referred to as reputation bootstrapping.

Trust can be explained simply by how one can rely on another and in our case how a customer can rely on a product or a service or even a company. One way to measure trust is how a customer can assess a product just by looking at its attributes and features and another way is to just leave it all on the company who is offering the product. If one trusts the company, one trusts the product based upon its reputation.

Rating on the other hand is totally different as it measures the trustworthiness of a product based upon certain parameters and performances. Several existing models have comeup with multiple parameters and frameworks to differentiate high-quality products/services from low-quality products/services. But still there is a need to build such a framework which not only dirrentiate among different products from high quality to low but also offers suggestion/s based upon the users' selection criteria [5, 6].

2.1. Feedback

Feedback, recommendations and referrals work to an extent of an existing product or service but when faced with an unknown (new) product or a service with no previous experiences or observations, it has its limitations exposed. Such a limitation is termed as the "reputation bootstrapping problem" [7]. Numerous frameworks do provide the rating system and multi-product comparison but none addresses the bootstrapping problem. Several attempts were made to provide a solution for bootstrapping but still there is a need to find a general framework that helps find the specific model for a specific product [8, 9, 10].

2.2. Rating

Rating is only as good as raters' caredibility. And it has become a gigantic problem for calculating rating for a product or service. False rating can damage the overall reputation assessment of any product or a service and vice-versa [11]. Existing frameworks does not take into consideration this problem and assumes that the given rating a product is coming from a credible and authentic source [12], which in our opinion is often unreliable and hence cannot be trustworthy.

The quality of products and services advances with time and thus causes changes in the rating parameters; as a result changes/adjustments should be implemented in the trust rating in order to provide a fair assessment of the product or services and consequently of providers. This aspect is known as "trust dynamism". Not all frameworks take into account this type of alteration [13, 14].

Current models do solve the issues releted to reputation and performance assessment but most of them ignor an important issue of credible rating, trust dynamism, and especially bootstrapping.

2.3. Objectives

The proposed framework targets at building a system trust for online products and services with its main objectives are:

1. Develop a framework for establishing trust among products and customers.
2. Address the bootstrap problem for online products and services.
3. Fix the issue of raters' credibility when calculating trust by introducing the grain level approach.
4. And finally establishing online provider's/company's trust.

3. Literature Review

Previous studies have taken various trust aspects into account. A survey was done by [15, 16] considering the general view of trust management which also studied the three parts of trust: trust management definition, models of trust management, and lastly models of trust information. The prime focus of this survey was on trust startup and the trust assessment in trust management systems.



A structural model of customer satisfaction and trust in vendors involved in mobile commerce was provided as shown in figure 4 below.



Figure 3. Customer trust in the vendor.

As described in the figure above; it is clear that customer satisfaction inevitably leads to customer trust, which is the ultimate goal of vender [15].

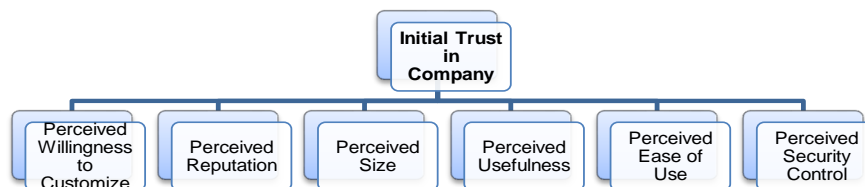


Figure 4. Research model for initial Trust in the company for new Customers.

According to [17], the initial trust is based upon the perception of the company and the usefulness and ease of use of the website presented by the company.

However, in order to gain system trust as a whole, there are some standards and features required such as ratings, seals, and guarantees, as shown below in table 1.

TABLE 1. Features of trust mechanism.

Key concepts reflected in mechanism	Seal	Rating	Guarantee
Risk reduction	✓	✓	✓
Service quality	✓	✓	✓
Trust	✓	✓	✓
Third party	✓	✓	
Independent verification	✓		
Customer feedback		✓	
Privacy		✓	✓
Guarantee (risk insurance)			✓
Security			✓
Self-reported			✓

In addition to that, there are several features that can also be added to the must list to acquire system trust, depending upon the type of products/services and risks associated with it [18].

The trust-relationship established between a customer and the products/services which are provided in the versatile market can be used as a long term connection and more importantly a way of getting additional advertisement and promotion of both the product and the provider. As providers and products which can gain the trust of the customers; they not only get good feedback and ratings but also customers will spread word-of-mouth.

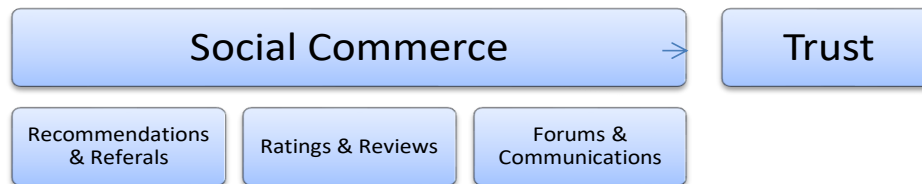


Figure 5. Research Model.

Some focus on consumer feedback, recommendations or referrals as the reason for a technique called ‘social word of mouth’, as shown in figure 5 above [19].

According to [20, 21, 6], the relationship length between a client and a supplier directly affects the relationship between this client and the service provided to them. Essentially, system trust is the idea of enabling successful transactional participation between two or more parties.

Different aspects are taken into consideration once a customer is intending to filter check by a new company. In most cases, customers are more likely- going to believe an organization on the off chance that they see it as being extensive in size what's more, having a moral reputation. Nonetheless, according to some research, for certain organizations and products it might be necessary to consider their size such as Apple, Sony, and Samsung. Overall, no doubt trust influences clients’ tendency positively towards an organization; the customers who are determined to trust an organization have a higher chance of purchasing from its website. The effects may occur instantly or gradually by lowering the risk level sensed by a client towards a particular organization during the performed transactions.

There are several factors consumers mostly review when they come across a new company during their shopping process. They can be regarded in a way in which consumers are going to trust the new company by; such as its product range, product category, rating benchmark, and some environmental factors [22, 23].

When a customer is searching for a particular product rather than a specific company this procedure is actually a standpoint of system trust which is called Personalized Trust. Furthermore, if this customer is searching for existing products, this search will involve a new or existing company. If these particular products are found in an existing company, therefore similar benchmark is regarded.

In all perspectives of trust, the rating benchmark is utilized for personalized and generalized trust evaluation. The rating benchmark ultimately is consisting of several elements such as environmental factors as well as comparative rating range when a consumer wants to search the rating of similar goods offered by various companies. The comparative rating range consists of seller rating, multi-source feedback, and comparisons of grain. A comparison of grains consists of multiple factors that are used to check the rating in an instance.

Although the online stores have more advantage than the physical ones for having products that are cheaper, delivered quickly to customers and in addition to that, the ability to sell a wide range of branded products still have to compete in the online market get their product sold. In order to become favorites than the other online retailers, it all depends on the level of trust one vendor or retailer has by its customer. Therefore, there are more features these retailers need to adopt to build a trusted relationship with their current and potential consumers [24, 25, 26].

These retailers need to have:

3.1. Consistency:

Online shops need to be consistent in all of the details that are related to customer-service; starting from the quality of products, packaging to reliable and on-time delivery. Credibility could worn-out if the store fails to accomplish the promised terms.

3.2. Accessibility:

Retailers need to manage an active and sufficient customer-service team that effectively responding to consumer’s concerns. This method offers clients a way of reassurance that they are interacting with an actual party.

3.3. Rewards:

Long-term rewards provided by a vendor or retailer such as gaining points for particular purchases, loyalty gifts are effective for encouraging people to repurchase from this store again. A familiar case for this is ‘Amazon Prime’. This feature ultimately offers its subscribers the advantage of being delivered any product within 48 hours for only \$79 annually. In addition to gaining loyalty from customers, these clients are actually getting used to receiving their deliveries in 48 hours or even less [16, 27]. The customer privacy



and technology plays an important role in this as well [28-30] which helps in completion of the transaction. At the same time customer privacy linked with the user location [31] while using the smartphone or mobile Cloud is important as well.

3.4. Electronic commerce trust reviews can be established through:

- i. E-Word-of-Mouth, which are provided by a close circle of people around us like friends, family members, and neighbors;
- ii. Standard comments and suggestions on particular products by experienced individuals;
- iii. Reviews provided regularly by consumers who offer them in a transparent manner;
- iv. More satisfaction reviews are given to certain products or services.

4. Proposed System Trust

In our proposed framework, System trust is categorized into two levels; first is generalized trust and the other is personalized trust. In generalized trust, we can apply a search by a new company and existing company. If the consumer chooses to search through an existing company then they will check its static rating which already exists. In a static rating, the approach depends upon individuals with higher trust evaluations that are probably going to concur with each other about the trustworthiness level of a company.

As the End-User begins with System Trust which has 2 main categories: a) Generalized Trust and b) Personalized Trust. In generalized trust the end-user has two options: 1) either search by Existing Company or 2) search by New Company.

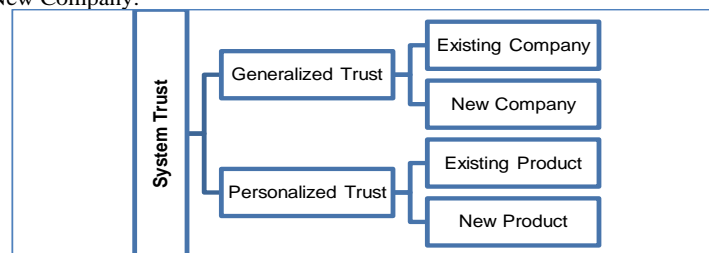


Figure 6. a. System Trust for an Existing Company.

Now following the pattern given above; the end-user selected a New Company. In this option, a product range will be displayed to the user along with the 'Rating Benchmark'. In which the rating for the company as a whole is provided, as well as for each product offered by the New Company.

Rating Benchmark concludes rating for the company but also gives an insight to the end-user to the Grain Level Comparison of the selected product.

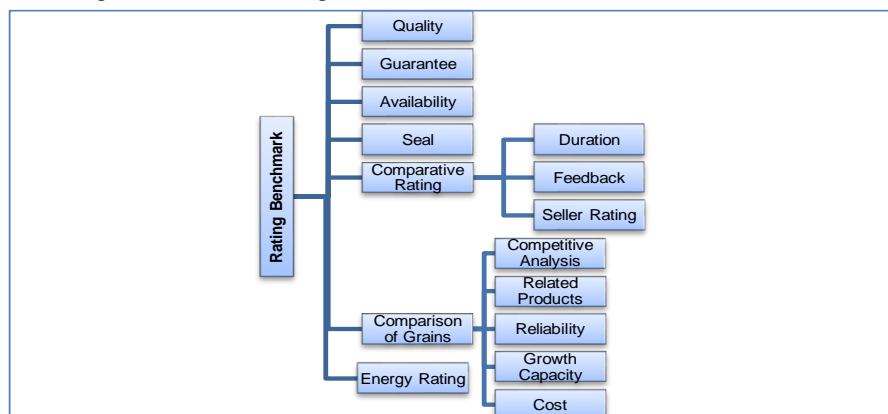


Figure 6. b. Rating Benchmark.

The detailed framework of the Rating Benchmark is as follows:

4.1. Rating Benchmark

1. **Quality:** It will show the Quality of the product or service which will be calculated upon the followings:
 - i. Assessment of Product/Service
 - ii. Accuracy of Product/Service
 - iii. Responsiveness
 - iv. Empathy
2. **Availability:** whether the product in demand is available or not.
3. **Guarantee:** company guarantee of the product i.e., the company is trusting upon the product as such that it is willing to give a guarantee (e.g., 1, 3, 5, 10 years) that the product won't malfunction. For customers it is deciding factor whether to buy the product with a few years of guarantee.
4. **Seal:** it is the certification or a stamp of a standardization authority verifying that a particular product has been certified e.g. ISO 9000 certification.
5. **Comparative Rating**
 - i. Duration: it is time taking to search, finalize and order the product on the company's website.
 - ii. Feedback: comments regarding the product from the consumers after using the product.
 - iii. Seller Rating: some websites also give a sellers' rating for an existing as well as a new product just like asking a shopkeeper's opinion.
6. **Comparison of Grains**
 - i. Competitive Analysis: it gives the grain for grain comparative analysis of the chosen product against the competitive products.
 - ii. Related Product/s
 - iii. Product Reliability
 - iv. Growth Capacity: if a product can have enhanced features or not e.g., an updated operating system or an extended SD card memory in a cell phone.
 - v. Production Cost/Expense
7. **Energy Rating:** as the world is going hence the products are going green or more energy-efficient. So it shows the energy efficiency or energy consumption or a particular product e.g., energy rating on a fridge, air conditioner or a washing machine.

System Trust for Existing Company

System trust for an Existing Company will begin with generalized trust as shown in the Figure below. System trust framework for the existing company is as follows:

Personalized Trust

New Product of Existing Company

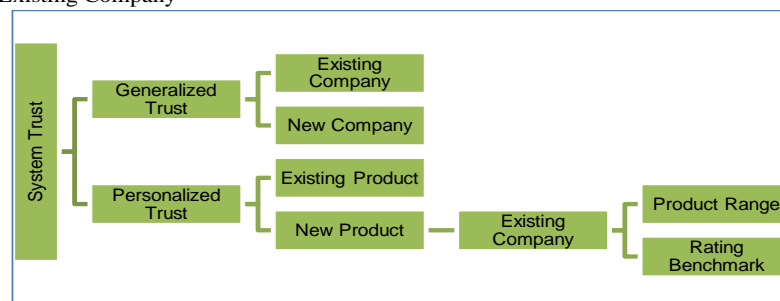


Figure 7a. System Trust for a New Product of an Existing Company



Figure 7a shows the category for a new product of an existing company under personalized trust, which has 2 further sub-categories as Product Rating and Rating Benchmark. Product rating is described as the company's rating given to the product.

Rating benchmark as shown below in figure 7b, is the end result of combining the seal (seal is just like standardization for example, ISO 9000), the service or product vendor guarantee, provider's service availability, the company's self-rating, turnaround efficiency, organization's concerns toward the environment, the quality level of the products or services provided, buyers' feedback, reliability, safety and lastly comparative rating range. The quality of the services delivered is concerned about service evaluation, service accuracy, responsiveness quality toward clients, and empathy as well.

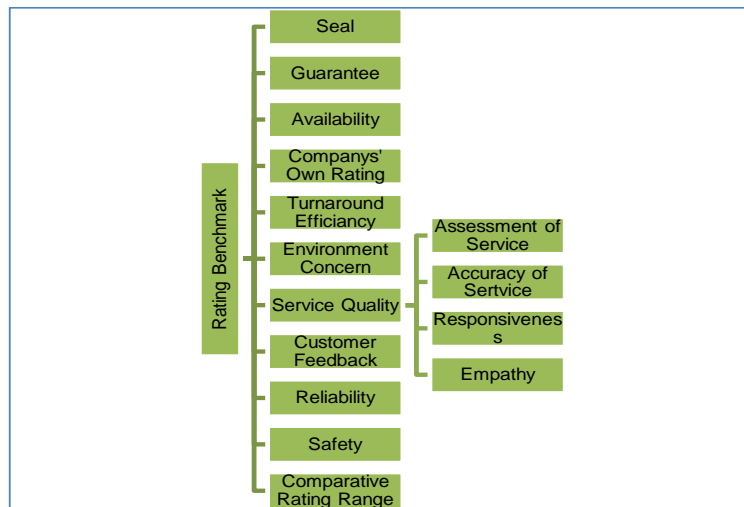


Figure 7b. Rating Benchmark for a New Product of an Existing Company.

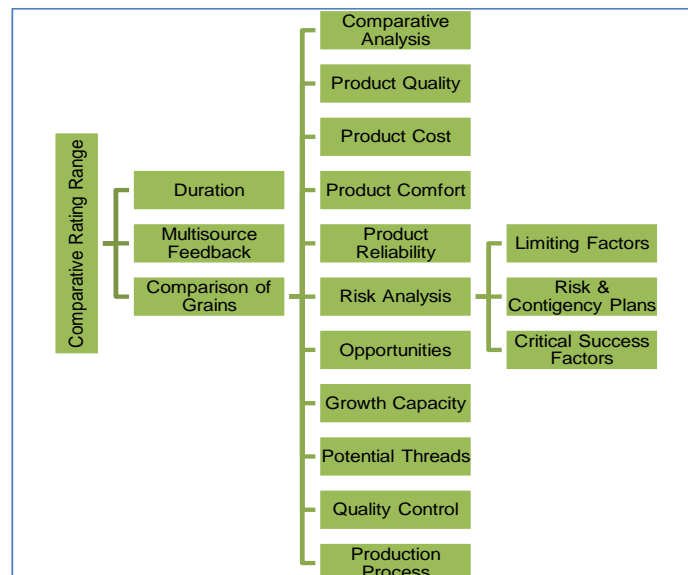


Figure 7c. Comparative Rating Range for a New Product of an Existing Company.

Comparative rating range is computed through multisource reviews and grain comparison. Furthermore, comparative rating range consists of comparative analysis, quality of the end products, product cost, product comfort, the reliability of the delivered product, risk analysis, opportunities (of what), growth capacity, potential threads, control of quality, and procedure of production. Risk Analysis mainly considers three aspects of risk which are listed as limiting factors, contingency and risk backup plans, critical success factors as shown in figure 7c.

And finally System trust for a New Product will begin with Personalized Trust as shown in the figure below.

Personalized Trust

New Product of New Company

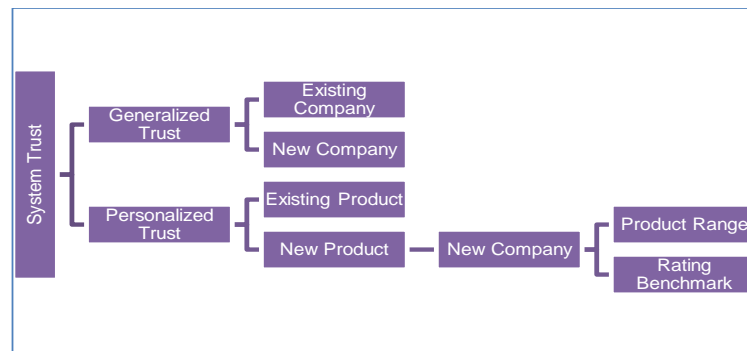


Figure 8a. System Trust for a New Product of New Company

Figure 8a shows the category for a new product of a new company under personalized trust, which has 2 further sub categories as Product Rating and Rating Benchmark. Product rating is described as the company's rating given to the product.

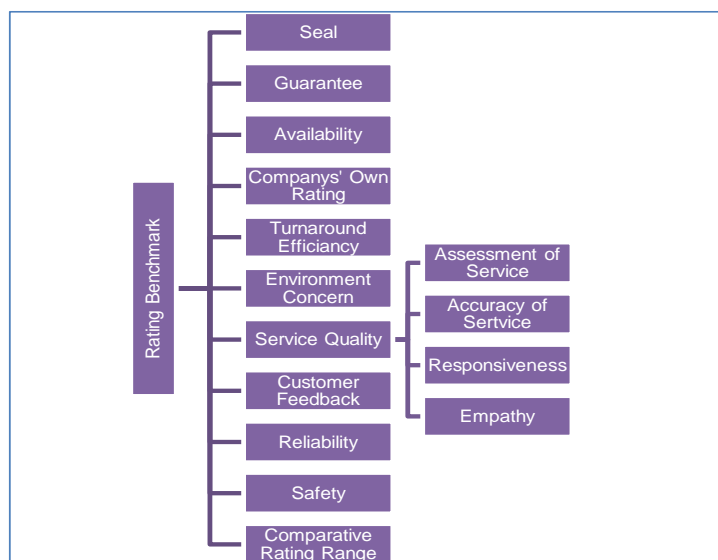


Figure 8b. Rating Benchmark for a New Product of New Company.

Rating benchmark as shown above in figure 8b, is the end result of combining the seal (seal is just like standardization for example ISO 9000), the service or product vendor guarantee, provider's service



availability, the company's self-rating, turnaround efficiency, organization's concerns toward the environment, the quality level of the products or services provided, buyers' feedback, reliability, safety and lastly comparative rating range. The quality of the services delivered is concerned about service evaluation, service accuracy, responsiveness quality toward clients, and empathy as well.

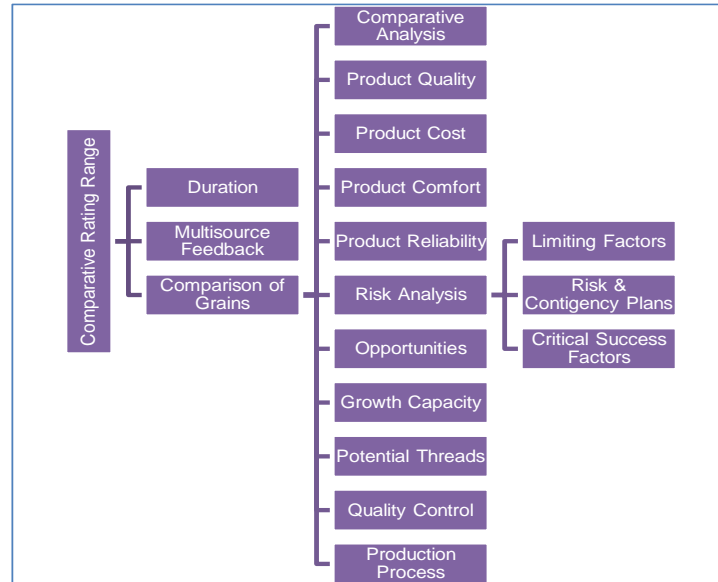


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A Case Study Algorithm to Validate the Grain Level Rating

In order to validate our system explained above; let us take a case study of a cell phone as an online product. As per the proposed framework the following should be the algorithm taken into consideration for the optimum product i.e., a cellphone.

Below is the given the algorithm to calculate the rating for a cellphone product at grain level comparison:

- i. *Memory*

$$(2ra + 2ro + 1cs) / 5$$
ra = RAM; ro = ROM; cs = Card Slot
2 is the weightage given to RAM & ROM because of their importance in the segment of memory divided by 5 which is the total number of items in this segment
- ii. *Body*

$$(1bt + 1wp + 1sim + 1wt) / 4$$
bt = Built; wp = Water Proof; wt = Weight
- iii. *Platform*

$$(1os + 1chs + 1cpu + 1gpu) / 4$$
os = Operating System; chs = Chipset
- iv. *Camera*

$$(1pri + 1sec + 1f + 1pa + 1sa + 1ss + 1ios + 1fea) / 8$$
pri = Primary; sec = Secondary; f = Flash; pa = P. Aperture; sa = S. Aperture; ss = Shutter Speed; fea = Feature

- v. *Features*

$$(2n + 1usb + 1r + 1nfc + 1fc) / 6$$
n = Network; r = Radio; fc = Fast Charging
- vi. *Display*

$$(1ty + 1pro + 1sz + 1res) / 4$$
ty = Type; pro = Protection; sz = Size; res = Resolution
- vii. *Battery*

$$(2mah + 1rem) / 3$$
rem = Removable
- viii. *Sensors*

$$(2fsc + 1hr + 1sp + 1acc + 1gm + 1bm + 1com) / 8$$
fsc = Finger Scan; hr = Heart Rate; sp = SPo2; acc = Accelerometer; gm = Gyro Meter; bm = Barometer; com = Compass
- ix. *Company*

$$(1cn + 1pq + 1sq) / 3$$
cn = Company Name; pq = Product Quality; sq = Service Quality
- x. *Availability*

$$(2pt + 1acs) / 3$$
pt = Parts; acs = Accessories
- xi. *Warranty*

$$(1rat) / 1$$
rat = Rating
- xii. *Seal*

$$(1seal) / 1$$
- xiii. *Grain*

$$(1mem + 1bd + 1pf + 2cam + 1fea + 2dis + 1bat + 1sen) / 10$$
mem = Memory; bd = Body; pf = Platform; cam = Camera; fea = Features; dis = Display; bat = Battery; sen = Sensor
- xiv. *Benchmark*

$$(1gr + 1com + 1war + 1seal + 1av) / 5$$
gr = Grain; com = Company; war = Warranty; seal = Seal; av = Availability

For example if a customer is interested to buy a specific company's cellphone, with a preferred display size, ram and rom with a battery of 4k mAh; then the following will be calculation for the new cellphone's rating:

$$\begin{aligned}
 \text{Memory} &= (2ra + 2ro + 1cs) / 5 \\
 &= 2 \times 16 + 2 \times 32 + 1 \times 2 = 50 / 5 = 10 \\
 \text{Company} &= (1cn + 1pq + 1sq) / 3 \\
 &= 4 + 4 + 4 = 12 / 3 = 4 \\
 \text{Display} &= (1ty + 1pro + 1sz + 1res) / 4 \\
 &= 1 + 4 + 6 + 5 = 16 / 4 = 4 \\
 \text{Grain} &= (1mem + 2bd + 2pf + 2cam + 1fea + 2dis + 1bat + 1sen) / 10 \\
 &= 10 + 2 + 2 + 2 + 1 + 8 + 4 + 1 = 30 / 10 = 3 \\
 \text{Benchmark} &= (1gr + 1com + 1war + 1seal + 1av) / 5 \\
 &= 3 + 4 + 4 + 2 + 2 = 15 / 5 = 3
 \end{aligned}$$

The trust algorithm calculates the grain of 3 which gives the new product a rating of 3 out of 5.

Note: The weightage of each entity will be increased upon user's preferences, such as, first preference, second preference and third preference.

The above algorithm also works under the user preferences such as, if a customer wants to buy a cellphone with a specific display in mind (e.g., 6 inch display); hence the display feature in the calculating the Grain will be given additional weightage. The system will bring forth only those cellphone product with the user mentioned display size and then, after performing the grain level comparison, suggests the customer with the appropriate product.

5. Conclusion

The proposed system provides a comprehensive detailed analysis of the product in focus. It measures the grains of the product and then compares it with other products with similar features selected by



the user. The customer can also change the user preferences to have a different grain comparison. The customer can also add multiple products to compare with each other. Existing systems provide a comparison of the basic parts and characteristics but miss the mark when it comes to the issue like bootstrapping. The proposed system offers a comprehensive grain level comparison which provides the exact information and features the user is looking for, in order to purchase the product.

The proposed system also offers the users to select his/her preferences to search the product, for example, if the user wants a specific function or a feature as a preference then the system will show only those products with that requested preference and then the user can compare its grains with other similar product to finalize its decision. Besides the existing system do not provide the rating of a new product of a new company and also a new product of an existing company which causes the issue of bootstrapping for the potential consumers regarding the quality rating. Whereas, the proposed system, using the grain level comparison, establishes the actual rating for all the products including the new ones. This offers a potential solution to the problem of boot strapping as the user can assess the accurate rating of a product by comparing it with other similar products.

The proposed system gives the basic framework for each type of product i.e. i). a general framework ii). an existing product of the existing company, iii). a new product of an existing company, iv). a new product of a new company. We validated our proposed framework using a case study of online cellphone purchase as a product which shows that the proposed framework does provide the rating of a new product using grain level comparison approach. It gives the customer a meticulous evaluation of the product in focus; hence the customer can trust the evaluated rating and purchase and product. This not only gains the trust for the product only but also on the vendor and consequently on the system itself for future online purchases.

6. Future Work

As of now, this is an open area for standardization; hence a lot of work still needs to be done in order to generate several models and frameworks for multiple online products as one single model cannot be applied to all the products because of the difference in grains of each product. A separate trust framework needs to be generated for similar online products having the same grains which will eventually achieve the ultimate goal of gaining customer's trust.

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