

ECONOMIC OPTIMISATION OF QUALITY FOR GEOINFORMATION PRODUCT

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Abstract

There is an important distinction of understanding the quality as seen from the buyer's or producer's perspective. Different aspects of (the) quality influence the costs for the producer and benefits to the user. The producer usually establishes the level of the quality. The qualitative product for the user is a product that meets his needs. What is the economically rational level of quality? The economically rational level of quality is the quality that brings the highest benefit to the user and maximizes the profit for the producer. The optimal point for the producer to make maximum profit is where the difference between the benefit of the quality produced and the cost of production is the highest. Measuring the quality enables to establish the level of the value the product has to the buyer. Costs of measuring the quality are discussed in this paper. Warranties, standards and brand names reduce the costs of measuring.

The discussion is in terms of a single quality dimension, but it must be expanded for two quality aspects (e.g., precision and completeness of a dataset).

1 Introduction

The value of the Geoinformation product for the user is related to the use of the product and the benefits the user can draw from using it. In Section 2 we explain the value of the GI product for the user. The value is in the product's possibilities to improve the decision. The possibilities of creating the value are in implementing the concept of the product specific advantages (easy to use, reliable, fast, etc.) and product differentiation. The GI product has a broad array of possible forms and characteristics. The value of the product for the user can be measured by time (faster decisions, faster response), and by lowering the risk of taking the wrong decision.

In Section 3 we show the costs associated with the creation of the value. Within the production process the producer establishes the value of the GIP (transformation of the raw material to a product). The product that meets the user's expectations is more valuable to him. Traditionally, the producer concentrates on providing high level of technical quality, which is often associated with high accuracy of the datasets and more

detail. This strategy leads to high costs and consequently high price for the product. The buyer decides if the price set to the product is worth buying it or not. The decision taken depends on the value the product has to the buyer. The value of the GIP and the price influence the quantity of the product demanded.

The relation between the value of the GIP and the quality is not linear (better quality does not necessarily have high value to the buyer). In Section 4 we show how different levels of quality influence the benefits for the user. The discussion is supported by the car navigation example. What is the economically rational level of the quality? The level of quality that is optimal for the user and producer. Only the quality demanded by the buyer (and provided by the producer) and the price set according to the value the product has to the buyer can lead to satisfaction for the user and profit for the producer. Section 5 concludes with the observation that there exists only one level of quality where the difference between benefits and costs is the highest (optimal quality). In the last section we discuss the measuring of quality and the cost associated.

The discussion is in terms of a single quality dimension. Further research work must be expanded for the two quality aspects (e.g., precision and completeness of a dataset).

2 Value of the Geoinformation Product

The value in this discussion is the value the Geoinformation product (GIP) has for the user in a decision process. The value the GIP has to the user is in its possibilities to improve the decision-making process (and with this in its use). The value defined by the buyer leads to the decision if the product is worth buying it. A GIP is packaged as a product for specific use and offered to a specific group of users. Most of the Geoinformation products will be newly developed. For a newly created product the producer has no orientation how the market will react, whether the product will perform as planned, what will be the level of acceptance for GIP, what will be the value of the GIP to the buyer. The value of the newly developed product is difficult to measure (no past experience exist). Meeting the expectations of the buyer has the highest value for him.

2.1 Geoinformation Product

A Geoinformation product is a package of a solution-providing service. The importance of a GIP is in its optimal contribution to a user's decision process. It enables the user to take faster and justified decisions. A GI product's characteristics (easy to use, reliable information, etc.) bring advantages to the user and contribute to the decision. Meeting the objectives and expectations of the buyer is possible only with a specific product (not a 'multi-purpose' product) created for a specific group of users. To achieve GI product-specific advantages we differentiate the GI products. The potential for differentiating GIP is mostly determined by factors of data quality (limitation of the quality that is sufficient for one use, but not for another).

2.2 Value Linked to the Use

The value of the Geoinformation product for the user is related to the use of the product and the benefits the user can draw from using it. The value to the buyer should not be mistaken for the quality (usually established by the producer). For example, the GI product with a high level of quality (high positional accuracy, detailed attributes, high

logical consistency, etc.) might not be of any value to the buyer who needs a small amount of data on a small scale (only as base data for the presentation of the situation). The buyer creates a vision, a picture of a product's preferred attributes and performance. The product that meets the user's expectations has a higher value for him (satisfaction is influenced by the expectations). The value is established in the production process (transformation of the raw data to a GI product).

2.3 Forms of GI Product

A Geoinformation product can be designed in various ways. The design of a GIP's attributes and performance should be based on the user's preferences and needs (market research). GI product-specific advantages will become a rule to survive for a GIP producer (enabling them to successfully compete on the market). The most obvious forms of Geoinformation products are:

- combined different sets of the dataset,
- datasets integrated with the simple software routines or
- services offered with the help of the Geoinformation product and in advance defined queries and analysis.

Producer imagination and the need of the potential users limit the possibilities of different forms of GIP. The form of transformation mostly depends on the complexity of the GI product.

2.4 Measuring the Value of the GIP

The value of the Geoinformation product is in improving and shortening the decision-making process. The real measurable improvements for the user (using a GIP in the processes) are in:

- reducing the time needed for taking the decision
- better decisions, supported with reasonable arguments, data and information, and
- lowering the risk of taking the wrong decision (improvement in reliability, certainty).

The value of the GIP can also be measured by the time of response (how much time was needed to get an answer to a given question or query) and reduction of time spent on analyses (how much faster are analyses performed with the help of GIP). The real value can be reasonably estimated by the comparison of using the old process of taking decisions with the improved process using a Geoinformation product.

3 Cost of the GI Product

Development of the GI product causes additional cost, which is higher for the producer (and minor for the buyer). The height of the cost depends on the complexity of the product and with this on the additional resources required. Additional resources and more effort are required in the designing the product (specification that meets user needs), and planning of the development. The producer can expect reasonable return on his investment only for the GI product that is demanded and accepted on the market. The GI product should be produced if its value to the user is higher than the cost of development and production.

3.1 Cost of Establishing Value

The value of the GI product is established in the production process and causes additional cost for the producer. The value is achieved with the transformation of raw material to a product. Within the production process the GIP is physically created (datasets are combined, data are integrated with the software routines, etc.) and packaged as a product. Each step in the process has a sense only if it creates a value to the user. The most important part of the designing is the determination of the attributes and performance of the GI product. The design should be based on the user's preferences and needs (market research). The producers might find ways to involve buyers in the design of the product, and define the characteristics and parameters of the product in cooperation with the potential buyers (minor costs for the buyer). This may be done with the help of interviews, market surveys, or questionnaires. The net value of the GI product is in the improvement of the decision minus the costs of acquiring and using the GIP.

3.2 Cost of the Quality

The producers of the dataset are striving to provide a high level of quality. Providing a high level of quality has historical roots and was mostly adopted by the National Mapping Agencies. This strategy (forced by the producer) was in most cases not successful. The producer did not get reasonable return on his investment in data collection. Striving to provide high level of quality leads to additional costs due to costly dataset collection. The costs of providing the quality grow exponentially (cost curve).

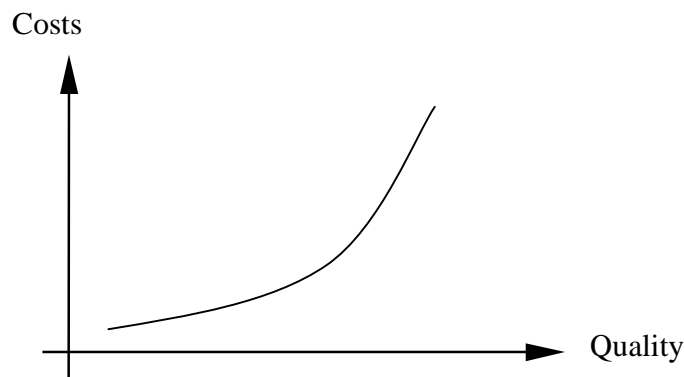


Fig. 3: Cost of providing quality (cost curve)

To recoup high costs of collection, the producer sets a high price for the datasets, which leads to costly products and low demand.

3.3 Price based on the Cost

The producer sets the price according to the level of quality and not according to the value the product has to the buyer. A high level of quality (as seen from the producer perspective) has a high price mostly due to costly collection of the datasets and cost of resources spent for the creation of the Geoinformation product. This strategy is in contradiction to the value the quality has to the buyer. In the case that the quality was not demanded by the buyer it has low value for him. If the GI product has low value to the buyer, he will not be willing to pay a high price for it.

Bargaining is an extreme example of finding the limit of the value the product has for the buyer. The deal is made at the point where the value and the price meet the buyer's expectation. This is difficult for the buyer, who has no real possibility of measuring the quality of the product. The seller reduces the price to the level that still yields acceptable profit.

4 Quality of the GIP

We identify the quality of the GI product (as seen from the producer's perspective) and the service provided with the GI product. The producer of datasets and Geoinformation products is striving to assure high level of the quality. The producer focuses his activities on providing the quality and not on understanding the user's needs. What quality is demanded from the user? The benefit the quality brings to the user does not grow linear with the high level of quality provided. The idea is presented by the car navigation example.

4.1 Quality of the Product from the Producer's Perspective

The quality of a GIP is derived from the quality of the datasets used as a raw material for creating the GIP. At the early stages of development a GIP will mostly consist of different datasets integrated and repackaged as a GI product. The quality of the datasets is in most cases associated with the positional and attribute accuracy of the data. One can also measure or estimate other parameters of the quality, for example, logical consistency (the topology completeness – are all polygons closed, do all parcels have parcel numbers, etc.), or completeness measured with the percent of the data that were not collected (and were described in the specification for collecting). The most important parameter is temporal update level (or temporal accuracy). The quality of Geoinformation products can be created only from the actual, updated datasets.

4.2 Quality of the Service Provided

With the help of GIP producers will be able to offer additional services to the users. The quality of the services is difficult to measure objectively because of their intangible nature. One part of the quality of service performed with the help of GIP can be measured with objective criteria, for example, did we answer to the buyer questions, did we provide reliable analyses, or how fast did we provide the answer? The second part of the quality is difficult to assess and is based on subjective criteria (do we like the company providing the service, the person responsible for the service, etc.).

4.3 Benefits of the Quality

The producer should assure a certain level of quality in order to bring the benefit to the user. The benefit of using the GIP does not grow linear with the higher level of the quality of the product (graph, fig. 2). Up to a certain point (point A on the graph) the quality of the Geoinformation product is too low to bring any benefit when the product is used. Between A and B lies the quality demanded by the potential user. Within this limit providing higher quality would bring higher benefits to the user (using the Geoinformation product). Beyond a certain point (point B) improving the level of quality will not bring additional advantage to the user.

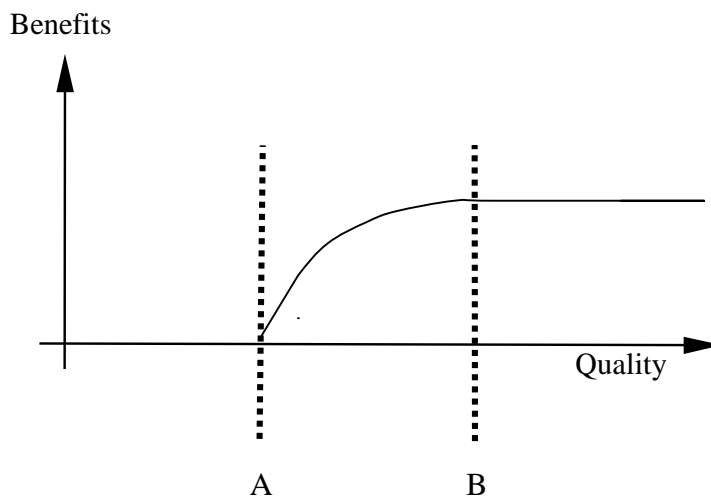


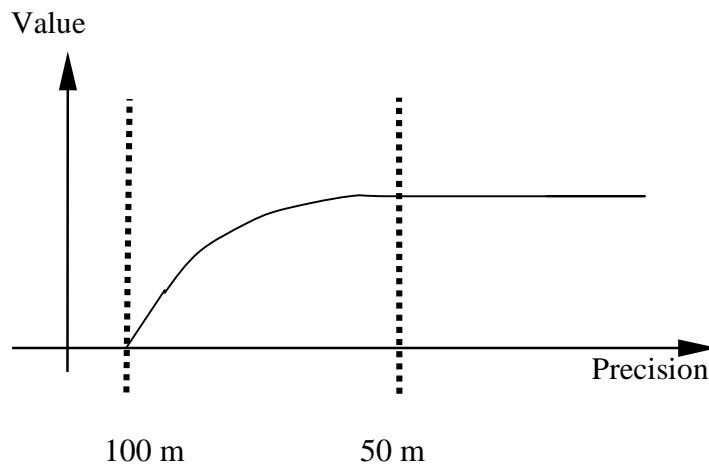
Fig. 2: Benefits of the Quality for the User (benefit curve)

The producer should decide what investment in the quality would bring benefits to him and to the users. The first question to answer is what level of quality is demanded by the user; does it mean a high value to the user and what are the benefits the buyer can draw from using the Geoinformation product?

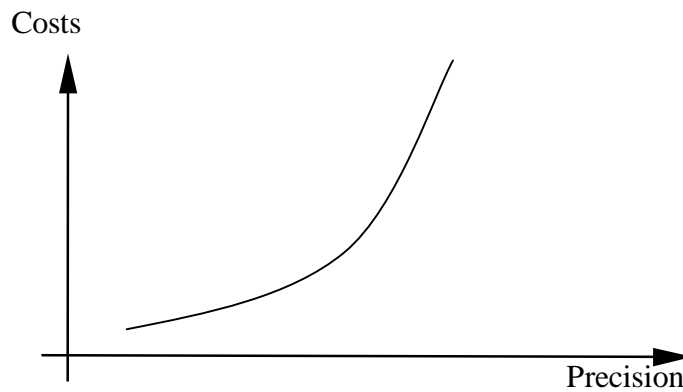
4.4 Example: Car Navigation

People preparing their trips need to know in which direction they should drive and which road to take. Car navigation is a simple and illustrative example.

The driver needs a certain precision (a certain level of the quality of navigation) to find the right road for driving to the selected destination. Very low precision (under 100 m, for example) has no value for the driver. With this precision he will easily miss the right road (accidentally choosing the wrong one). Higher precision will have higher value to the user of the car reducing the risk of the wrong decision.



The precision of 50 m has the highest value for the driver enabling him to exactly identify which road he is on. Higher precision has no additional value for the driver (as he can find the right road with the lower precision) and leads to higher costs (taking time to look at the map, etc.). The costs of providing the higher precision are rising exponentially.



What is the optimal level of the quality of navigation? A rational driver will choose the level of precision (at minimal costs) that assures him to find the right road and enables him to drive towards the selected destination.

5 Economically Rational Quality

The economically rational level of quality is the quality that is demanded by the user and maximizes the profit to the producer. What is the level of quality that brings higher benefit to the user than the cost producing it to the producer (profitable quality)? We

come to the conclusion by combining the cost and benefit curve. What level of quality is economically rational? There exists only one level of quality that is optimal for the user (high benefit when using the GI product) and the producer (difference between the cost and benefit is the highest).

5.1 Profitable Quality

For the producer is crucial to provide the demanded level of quality at lower costs than benefits and earn return on his investment. On the graph (Fig. 4) we identified three points, characteristic for our analysis; 0, A and B. On the interval from 0 to A, the quality has certain value to the user, but the costs of providing it are still very high.

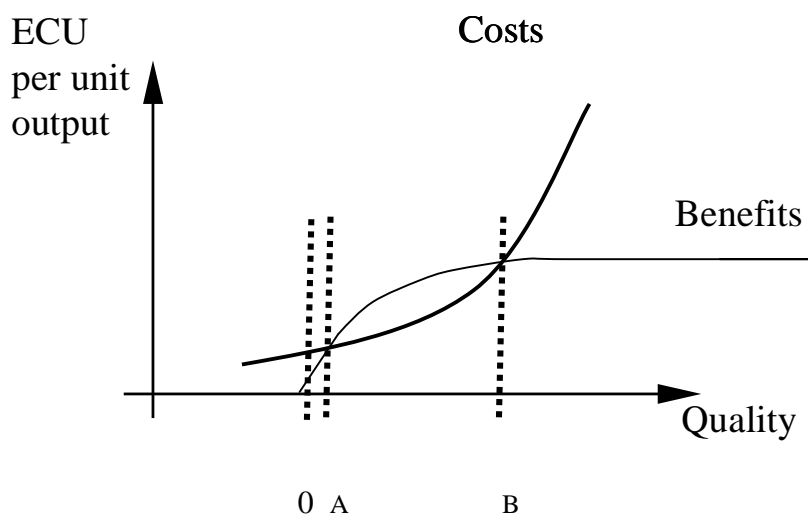


Fig.4: Profitable Quality

The most interesting part is interval A-B where the benefits exceed the costs. The producer of the Geoinformation product should strive to obtain the level of quality that has a value to the user and to keep the costs of creating Geoinformation product lower than the benefit the user can draw from using it (from point A to B on the fig. 4).

We can clearly see that at some levels of quality (closer to the points A and B) the difference between benefits and cost is small. At this level of quality the producer will make some profit and will be able to recover the costs of the creation and production of the GIP.

5.2 Optimal Quality

The optimal point for a producer to make maximal profit is where the difference between the benefit of the quality produced minus the cost of production is maximal (point X, fig.5). The buyer will decide for the option (GI product) that is valuable to him and can bring benefits using it. It is obvious that the higher level (than B, fig. 4) of provided

quality causes very high costs for the producer and does not influence the benefits to the user anymore. Providing this level of quality would cause high losses to the producer.

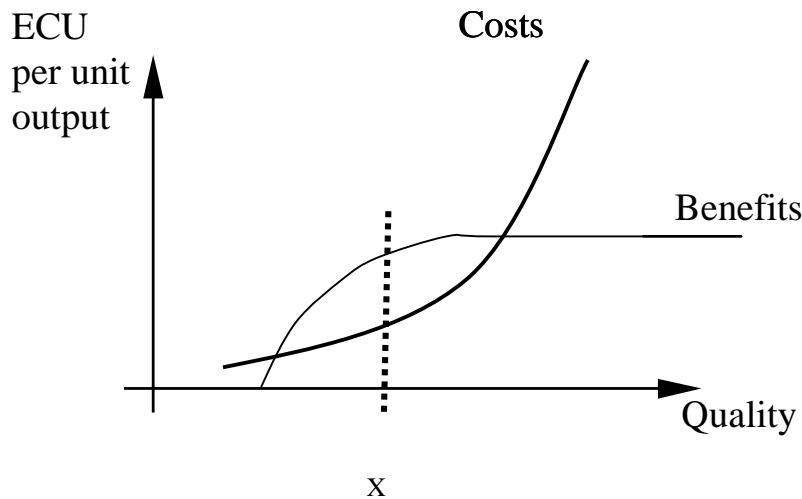


Fig.5: Optimal Quality (X)

6 Costs of Measuring the Quality

Measuring the quality helps to establish the level of the value the product has to the buyer. Measuring the quality brings about certain costs, which are (not equally) allocated between buyer and producer. For whom it is more costly to measure the quality depends on the distribution of the information. Costs of measuring the quality are lower for one who has more information.

6.1 Costs for the Buyer and Producer

The costs for a buyer are in measuring the quality, which leads to establishing the value, the product or service has for him. The costs for the producer are in measuring the quality of the competitors' products, establishing the appropriate level of quality (investment in R&D, benchmarking) and in retaining the same level of quality (or trying to achieve a better one). The costs of a particular method depend also on the relative costs of the alternative methods of measuring. To decide whether the measuring cost is worth paying, one can compare the expected utility without measuring to the expected utility with measuring.

6.2 Variable Quality

If the quality is variable, the costs of measuring the quality are higher for the producer and the buyer. Using such products involves a high level of risk. Changes in the level of the quality (variable quality) causes uncertainty and less satisfaction to the user (not meeting his expectations). If airline companies constantly changed the flight schedule, this would cause a great deal of confusion, among the international airlines and among

passengers. Or, for example, bank customers expect that the banks will not make any errors recording their account number and the amount of money in their accounts. Reducing errors in the product or services leads to less variability in the quality. Uncertainty of the quality is also lower if the product meets a specification and constantly performs according to this specification. This is difficult to achieve for certain products where we cannot predict the sequence of all tasks which can cause errors in performance (software bugs, for example, are difficult to predict).

6.3 Reducing the Costs of Measuring the Quality

We discuss warranties, standards, and brand names, which reduce the costs of measuring the quality of the Geoinformation product for a buyer. Using standard products and well-established brand names enables the user to avoid excessive measuring of the quality.

6.3.1 *Warranty*

Warranties assure a certain level of quality and lower the measurement costs of quality for the user. The producer bears the risk and costs if the quality (and functionality) is not as promised. The buyer is protected, sometimes only for the first year or the first two; after this period the responsibility shifts to the user. Recently, producers are competing on the length of the period warranty is provided for (for example, for some computers you can get up to three years of warranty).

6.3.2 *Quality Standards*

With the quality standards the producer provides the product according to the known specification and characteristics (as defined in the standard). This assures a certain level of reliability and certainty. The buyer can avoid excessive measuring of the quality and the costs for measuring are lower. The buyer's decision-making process is shortened. The producer offers his products everywhere in the global market at the same level of quality. The buyer knows exactly what he will get. In the case of standardization more costs incur on the producer's side due to additional effort and resources in fulfilling the specifications of the standard.

6.3.3 *Brand Name*

The producer is willing to deduce additional resources for establishing a brand name which means investing in reputation. It requires significant costs, effort (research, development, advertising) and high risk at the stage of creation. The advantages of a successful brand name are great. The buyer relates the attributes to an object (company, brand name, or product) and will not change his patterns of thought easily. Sometimes he blindly trusts a name as a symbol for quality (Sony for CD players, BOSCH for machines in housekeeping, etc.). Brand names are free of costs for the user, who need not go through the long decision-making process (less time and effort invested) in the pre-buying stage. Once the recognizable brand name is established, the role of the producer is to retain the same level of the quality in order to meet the buyers' expectations.

6.4 Distribution of Information between Buyer and Seller

Distribution of information between buyer and seller influences the perception of the value of the product. At early stages of development of the product the producer has more information. The buyer collects the information about the GI product. The flow of information goes mostly from the producer to the buyer. The information provided forms

the buyer's expectations about the attributes, characteristics and performance of the product. It creates expectations about the value of the GI product to the user. If later experiences using the product confirm promises to the user (and fulfil his expectations), this will create a higher value of the GI product to the user. After some time of using the product the user has more information sometimes than the seller does. At this stage the user is able to compare the GI product with competitive products or other alternatives.

7 Conclusions

A step further will be made when the understanding of different levels of quality will be recognized and accepted. The absolute concept of quality does not exist. Buyer and seller have different perceptions of quality and the value a certain quality has for them. The producer should accept the buyers' criteria and provide the quality of the product that has high value to the user. Major producers of the raw material (datasets) for Geoinformation products focus their activities on providing a high level of technical quality (high accuracy, more detail, etc.). This can be in contradiction with the buyers' expectations and needs. To focus on the creation of quality products is not the only condition for an efficient and successful strategy.

The question is still why the potential buyers are more aware of the problems and costs using a GIP than of the benefits they can draw from using it. A Geoinformation product should be designed in a way that it has a value for the buyer. Nowadays the producer is obliged to see his activities through the eyes of the potential users and to abandon the old approach. What level of quality is demanded by the potential buyer, should a high quality Geoinformation product be created, what has a value for the user: these are the questions which GIP producers should answer in the phase of designing the product.

Innovative strategies will become winning strategies. The GIP producer will have to plan his activities according to the demand of the potential buyer and his perception of the value. An active role – of both the producer and the buyer – in the phase of design and creation of the product and defining the attributes and characteristics will be required in the future. A more flexible understanding of the quality will create new opportunities for the producer of the GI product. Opening up new markets will offer new possibilities and ways of using the datasets and Geoinformation products.

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