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THE INTERPRETATION OF THE QUALITY OF LOGISTICS INFORMATION

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Abstract: The use of high–quality information in a warehouse and the operational results achieved through it is not a novel research topic. Numerous studies have already shown that good information enhances competitiveness. The correlation clearly points out that decision–makers, when armed with good information, are capable of making good decisions. However, acquiring good, accurate information poses challenges. While members of an organization tend to favor communication channels from which the accuracy of received information can be verified over time, this is by no means a guarantee of the information's quality. This is because it consists of a multitude of non–reproducible, intuitive decisions. Modeling information as a warehouse resource is, therefore, a challenging task. During such studies, we continually encounter difficulties, as the verifiability of this in a certain – undefined – environment is simply not achievable. My goal is to create a model that can support decision–making in warehousing.
Keywords: information value, information interpretation, corporate resource

INTRODUCTION

Based on my research, in the case of microeconomic models describing warehouse operations, there is an opportunity to objectively handle processed information, provided that we assign it some value. I intend to characterize the degree of truthfulness of the utilized information with a goodness factor, which I consider to be an expression of its objectivity. I interpret this factor with an efficiency–type characteristic between 0 and 1, making it mathematically manageable. In cases where it is not possible to determine the relationship of the information to objectivity, the processor of the information should be aware of it. Currently, information is not being treated at this level in warehouse management. Of course, the process of approximating probable reality is not unknown to science. However, in a warehousing environment, probability theory examines the occurrence of predefined, statistically not entirely independent events, which naturally follow certain regularities.

Such examinations can only be carried out and applied in an environment where reality is reproducible. Statisticians, for example, are familiar with the concept of the value of reality, and in many cases, they refer to it as a margin of error in statistical terms. However, based on my current research, there has been no application of this concept in the field of warehouse systems.

REALITY AND ITS KNOWABILITY

Logistics is an interdisciplinary field that fundamentally involves engineering, natural sciences, and social sciences. In engineering and the natural sciences, there exists an objective reality, meaning there is knowable information. If we do not consider it this way, there would be no such thing as engineering science. Researchers in these fields have the opportunity to understand objective reality. In the social sciences – in our case, economics – which is of paramount importance in logistics, the possibility needed to reproduce reality no longer exists. However, when we examine explicitly mathematical models in economics, such as those describing utility and costs, we once again move closer to objectivity.

Therefore, in the field of logistics, under certain conditions, we have the opportunity for objectivity, but only in the case of microeconomic models describing warehouse operations

Spatiotemporal Knowability

As highlighted in László Duma's doctoral dissertation, production and logistics processes are typically planned based on uncertain demand forecasts. This entails the risk that products are not manufactured or stored in the right quantity or composition [3]. In his work published this year, M. Christopher also drew attention to the increasing risk of relying on demand forecasts [4].

Therefore, the sole tool for risk management is to postpone decisions until better–founded forecasts are available. However, by delaying decisions, one of the most critical factors, time, is taken away from the procurers. As a result, they are likely unable to achieve the goals set by Szegedi and Prezenszki, namely:

1. Achieving optimal quality.
2. Minimizing total costs.
3. Identifying, selecting, and evaluating suppliers.
4. Contributing to low inventory levels and continuous product flow.
5. Collaborating and integrating with other organizational units [5].

If the risk of uncertain demand forecasts is significant and persistent, procurers have no choice but to ensure continuous production with high inventory levels, constant replenishments, or consignment inventories (The essence of consignment inventory is that the seller's stock is stored in the buyer's warehouse. The goods remain the property of the seller until they are used.), to meet customer demands quickly and cost–effectively [6].

On the other end of the spectrum, which is becoming increasingly common in the warehouse sector with the development of information societies, is that decision–makers have too much irrelevant information at their disposal alongside useful information. Typically, this occurs with the use of Radio–Frequency Identification (RFID) technology, which generates a large amount of data with "a push of a button." Without proper information management, decision–making time further increases [7].

Can it be asserted that the utilization of forecasted information leads to increasingly accurate information, remaining within tolerance levels?

Exploring the Internal Logic of Data Structures

The likelihood of information can be increased through statistical analysis and/or an analysis of the internal logical structure. Managing information as a resource also entails continually enhancing its real value.

This means that within the information environment, data should not be treated as a static factor but rather as an ongoing data management process, ensuring that these values are always as appropriate as possible.

To form a judgment about something, it is necessary to have some level of connection with the relevant process in space and time. Working in a physical or engineering system is only possible when our work is based on mathematically reproducible values. Since the acquisition of information is achieved through comparison with something similar, and this comparison can be precisely defined, the following conditions must be met for objective information to be acquired:

- We are either in the same place or in different places. We are talking about events in the past, present, or future.

Practical example

- We are either in the same place at the same time, providing us an opportunity for direct understanding.

Example: Our own inventory

- We are in the same time frame but in different locations, allowing for indirect (logical) understanding.

Example: Inventory in transit

- We are talking about a future event happening in the same location, but we can only understand it indirectly.

Example: Year–end inventory

- We are talking about a future event happening in different locations, but we can only understand it indirectly.

Example: Year–end customer demands

- We are talking about a past event that occurred in the same location, and we have the opportunity for direct understanding.

Example: Last year's orders

- We are talking about a past event that occurred in different locations, allowing for indirect (logical) understanding.

Example: Changes in customer demands

If you wish to determine a future expected event, you can only do so logically or based on past data. In this approach, what matters to us is whether the information was correct or incorrect.

- In the case where we can determine the expected consumption using mathematical methods based on past data, and this value matches the actual consumption value, we are talking about information that is both real and logically correct.
- However, if there is a discrepancy between the value of expected consumption determined based on past data and the actual consumption value, we can speak of a logically correct inference, but unfortunately, it is still an inaccurate value. In this case, the information derived from the inference triggers incorrect actions within the logistics organization. Therefore, incorrect, erroneous, or information with zero factual content cannot be considered as information in a warehouse environment.

However, it is essential to recognize that the use of the true (1) and false (0) values is not sufficient. Warehouses operate as dynamically changing environmental elements, and these changes induce their preparedness for future events. (They cannot operate a model that does not provide results if it cannot provide an exact value.) To ensure that the warehouse goes from the logically deduced expected value to the actual value, it is advisable to continuously review forecasts and logical inferences and supplement them with an expected "goodness value."

CHANGES IN THE QUALITY OF INFORMATION OVER SPACE AND TIME

Based on my observations, the factual content of data found in warehouse management systems is often known only to those who input it, and even they may not have a complete understanding. Meanwhile, users of the system often lack the ability to question the data within the system.

In an industrial environment, determining the daily production plan is a critical task. There are well–established methods for this, such as the minimum stock and minimum constant production strategy, which are used to determine the aggregated production plan almost automatically. Based on these, the master production schedule (MPS) is created.

To reach this point, basic mathematical methods are sufficient, but determining the necessary input data for the model's continuous operation is far from simple. The accuracy of demand forecasts determines the operation of the entire system. However, there is no need to worry because there are well–established subjective and objective methods for this.

Regardless of the method we use, whether it's estimation, expert consultation, Delphi method, time series analysis, etc., we still cannot predict the future. This means that anomalies can occur, where calculations proceed as planned, conclusions are correct, but due to unexpected disruptions (a supplier is delayed, a machine breaks down, a worker gets injured, etc.), the warehouse cannot produce the desired product.

While it's impossible to prepare for or model these events, and modeling them is even more challenging, the fact that the possibility of their occurrence always looms over a given warehouse means that there must be provisions for resource transformation capabilities (I will delve into this in more detail in a later section of my paper).

These models should not only serve the static analysis of the specific system but also provide for dynamic assessments capable of directly sensing vulnerabilities and pointing to necessary improvements [8]. The need for improvement reflects the importance of the element and its associated satisfaction level [9].

In my experience, the main problem lies in the disconnect between continuously performed demand forecasts and the resulting actual production outcomes.

In current warehouse systems, there is no requirement, and often not even a recommendation, for establishing a connection between forecasts made at different points in time, such that, upon later review, past values increasingly align with actual needs.

The quality of information should not be considered a constant value; it needs to be continually managed in the warehouse environment. The aim should be for this value to consistently increase, not decrease. It should reach a level that is certainly sufficient for the organization to make appropriate decisions. Until this is achieved, decisions made in the ongoing process should be continuously reviewed and revised.

Preconditions

Mathematically, it can be best expressed as follows:

- When the probability variable has a value of $p=1$, then objective reality is confirmed.
- When the probability variable has a value of $p=0$, we have no evidence to suggest whether the data we are handling is objectively real or not.

In practical terms, if at the moment of placing an order for a product or service, the assumed fulfillment probability is $p=0.1$, then when examining the expected probability of fulfillment at the moment of fulfillment, it should be greater than $p=0.1$.

In modern logistics systems, we are compelled to continuously review forecasting values. However, in one of the warehouse systems I examined, this type of "reprocessing" review does not function, and no one verifies these values.

Automating such a statistical verification process and incorporating it into warehouse operations is not inconceivable.

MEASUREMENT OF WAREHOUSE INFORMATION QUALITY

On the contrary, perhaps for this very reason, researchers emphasize the integrity of the represented information. In other words, research is restricted to the transmission of information where it can be clearly stated that its operation is considered appropriate only if the input signal passes through the system without distortion and can be transformed back to its original form.

Since the above theories largely avoid examining the objective value of input signals, modern decision support systems need to incorporate such approaches.

As is known, information and data are not the same. Just because I can reinterpret signals into meaningful data, it does not guarantee the desired actions that I intend to stimulate through the transmission of information. In the current economic environment, we consider information to be acquired "real" and "necessary" knowledge that prompts logical and intentional actions, or has the potential to do so for the organization.

From this perspective, disinformation does not carry the desired effect of promoting the interests of the warehouse, as although it prompts action, it cannot be clearly considered useful or usable information for the logistics organization.

In Werner Gitt's work titled "Information", he defines the value of information in terms of its usability. He distinguishes between valuable and worthless information [10].

As I mentioned earlier, in the business world, I can only consider information that prompts acquiring knowledge leading to actions that enable the organization to achieve its goals under specific circumstances. Therefore, in the diagram above, I assign value exclusively to information in the useful category. However, I want to go even further with this approach because, in a warehouse environment, useful information must also be necessary. This approach is based on the reality of the relationship between information and logistics in this field.

Approaching information management in this way cannot be considered trivial. On one hand, there is information that is measurable, has determinable units of measurement, while on the other hand, this value is based on an understanding, during which an event becomes a sum of properties, and we make assertions about these properties through their understanding. Hence, we need to narrow down the scope we intend to examine, focusing only on the properties of reality that can be made objective through their understanding!

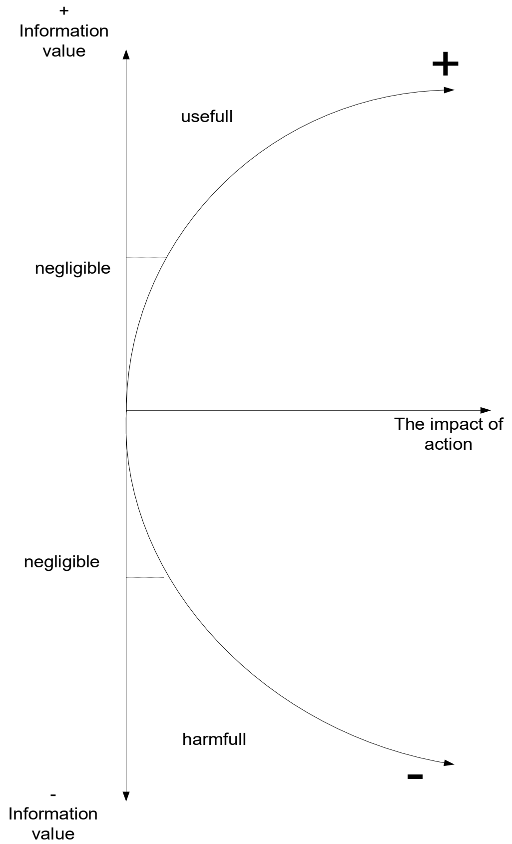

Figure 1. Werner Gitt's redefined diagram–based methods for evaluating information (self–edited).

CONCLUSIONS

The value of information's quality is determined by how necessary and real it is for the warehouse.

By "necessity", I mean the set of information that is indispensable for warehouse operations or can be substituted at a cost by involving other resources.

For me, the necessity of information in a warehouse environment can be interpreted within the range of 0 and 1, where 0 represents unnecessary and 1 represents necessary.

Under the value of "reality", I refer to the degree of closeness to the probable reality.

The determination of the degree of closeness should rely solely on objective procedures. This means that the event being evaluated:

- Must be replicable at any time,
- Must have occurred in the past (at least once), or
- I have no means of establishing its relation to objectivity.

For me, the reality of information in a warehouse environment can be interpreted within the range of 0 and 1, where 0 represents not real and 1 represents real.

$$V_{I_{gdn}} = I_r \cdot I_c \qquad (5.1)$$

Therefore, based on the above, I make the following statement to determine the value of goodness:

where:

V_{Igdn} = Value of Information goodness

I_r = Necessity of information (required)

I_c = Concreteness of information (concrete)

So, in a warehouse environment, the value of information goodness is given by the product of the necessity and concreteness of the given information.

If we do not have relevant information available and we have no means of objectively understanding reality, then the only option is to compensate for the missing information by introducing something extra into the information acquisition process, so that the non–existent or superficial data can be brought at least approximately to an appropriate value.

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ISSN: 2067-3809