

DRAFT

Eli's Memorial Article Part 2

Seeing the flow of money in the financial statements.

Fluid Dynamic Accounting

An Insight with Experiment That Makes Management Accounting a Science
With Hard Science Level Predictability

Yuji Kishira, Kojiro Tobita, Shino Hiiragi

Keywords: management accounting, fluid dynamic accounting, scientific accounting, TOC, Theory Of Constraints, Goldratt, industrial engineering, management, social science, throughput accounting

1. Introduction

“Why do so many cost reduction efforts not deliver the result as expected, even though everyone works these efforts so hard?”

Despite all the Kaizen (2008)¹ activities everywhere organizations reaching their cost reduction targets, there are many cases that the company's bottom-line performance has not improved at all. In some cases, the performance gets even worse.

Why does this strange phenomenon happen?

This article will reveal why cost reduction efforts do not deliver the result and provide the historical reasoning that explains how current accounting has lost its logical validity. Furthermore, this article will clarify the conditions that make management accounting a science with the level of predictability typically reserved for the “hard sciences”. In addition, it will define a simple formula to disclose a potential

breakthrough in performance by considering the flow of work in the organization as fluid, enabling us to treat the organization as a system with a constraint in the flow. A case study was conducted to validate the hypothesis using this formula.

2. Evaluation by Two Illogical Measurements

2.1 Does a Company Make More Money if Cost is Reduced?

“If cost is reduced, a company will make more money”. Is this statement true? If this statement is logically correct, all companies where employees devote their efforts to cost reduction activity must make profit. However, it is not always true.

Let's evaluate it by looking into the story of an American company as described by Dr. Eliyahu

¹ Kaizen is a common and important concept in Toyota as well as in other Japanese companies. Kaizen means

“improvement”.

Goldratt in *The Haystack Syndrome* (Goldratt, *The Haystack Syndrome*, 1990 pp26-28). A summary of the story follows :

In the early 1980s, a company, which had been profitable every quarter for the last thirty years unexpectedly fell into the red. The president of the company was fired and a new president was appointed. He was interested in only one thing – the bottom line. In order to raise profit, the president instructed his staff to stop producing all parts which could be purchased at a lower price than the company’s reported cost and have them outsourced. However, profit got worse. To further reduce costs, the president then ordered the assembly plants to improve efficiency by increasing production. By moving ahead orders not yet due for shipment and forecasting future demand, the plants successfully moved from running two shifts to being fully operational 24 hours a day, 7 days per week. Consequently, manufacturing cost decreased dramatically, and the company went back into the black. The new president received a bonus because of the result, but he did not know what to do with a pile of finished goods inventory, so he resigned. A year later, tens of thousands of employees lost their jobs, the company size became one third, and the name of the company was changed.

What are the underlying problems in this story? Dr. Goldratt claimed the wrong measurement exposed the company to risk. Dr. Goldratt said the following:

“TELL ME HOW YOU MEASURE ME, AND I WILL TELL YOU HOW I WILL BEHAVE. IF YOU MEASURE ME IN AN ILLOGICAL WAY... DO NOT COMPLAIN ABOUT ILLOGICAL

BEHAVIOR.” (Goldratt, 1990 *The Haystack Syndrome* p26)

In other words, **illogical measuring causes people’s illogical behaviors**. The new president had no intention of making the company worse; he just behaved illogically because he was evaluated by an illogical measurement. This story was in the early 1980s. Yet, if this illogical measurement still exists, current business operations might be exposed to the same risk like this American company.

2.2 Evaluation by Illogical Measurements

A closer look at this story of the American company will reveal evaluations by two illogical measurements, which are “illogical manufacturing cost measurement” and “illogical inventory measurement”.

2.2.1 “Illogical Manufacturing Cost Measurement”

Let’s look at a business where the sales of Product A are 10,000 and the cost is 10,333, thus the deficit is 333. The sales of Product B are 6,000 and the cost is 5,417, thus the profit is 583. It appears that the more you make Product A, the more deficit you will get. It is necessary to work on cost reduction of Product A, such as outsourcing it to the lower cost overseas manufactures. In fact, if outsourcing costs only 9,000, compared to current in-house production cost of 10,333, you can make a profit of 1,000 just by outsourcing. You might think it will help to increase the profit of the company. However, a totally different picture may appear by looking into the following analysis.

	Sales Quantity	Unit Price	Total Sales	Materials Cost Per Unit	Materials Cost (Variable Cost)	Operating Costs (Cost Allocation)	Profit
A	100	@ 100	10,000	@ 50	5,000	(5,333)	-333
B	50	@ 120	6,000	@ 55	2,750	(2,667)	583
Total	150		16,000		7,750	8,000	250

Allocation

Table 1: Pitfall of Manufacturing Cost by Allocation

Table 1 shows the breakdown of the profit for Product A and Product B. If you look closely at Product A, it has material costs (variable cost) of 5,000, and also includes allocated direct and indirect labor costs of 5,333. The total manufacturing cost of Product A is 10,333. Total sales of Product A are only 10,000, thus it seems like Product A is making a deficit.

However, excluding the cost allocation, the marginal profit is 5,000 (= Sales – Variable Cost). Then, Product A is in fact bringing money into the company, not a deficit at all.

When Product A is outsourced, it seems a profit increased. However, in reality, the allocated cost cannot be reduced easily. So 8,000 (Total Fixed Cost) has to be allocated only on Product B now. Product B will consequently make a deficit. Then, outsourcing Product B must be considered as well for cost reduction. This will be a negative spiral.

It becomes clear that a distorted decision was caused by manufacturing cost including allocated cost.

Allocation was not a problem in the past. In the beginning of 20th century, when an accounting method called “allocation” was created, most of

² It can also be pointed out that the cost allocation system is not only invalid but also is the most distorting factor for management decisions. “However overhead costs were distributed to cost centers, virtually all companies, in a second allocation step, allocated cost center costs to products based on direct labor... the costs were then be divided by the direct labor hours... to derive a cost center rate per direct

manufacturing cost was direct labor cost. Moreover, employees were paid according to their output, and since it was easy to lay off employees at that time, all those costs were variable costs. In other words, they were categorized the same as variable cost in Table 1, so they could be reduced anytime.

At that time, since fixed costs such as equipment and administration costs were only a fraction of total money, allocation of fixed cost was considered logical.

However, the circumstance has changed: direct labor cost became a small part of total expense; the ratio of indirect cost became very high instead. In addition, most workers are now paid fixed salary and it is not easy to lay off people. In such circumstances, allocating cost becomes illogical.

This issue has been discussed among academic experts in accounting for a long time. In the book, *Relevance Lost*² published in 1987, the issue was stated as follows:

“Academic accountants devoted much energy in the last sixty years to forging managerial relevance out of financial accounting.”

(Johnson, H. T., and R. S. Kaplan, 1987 p.145)

The learning here is **it is not wise to make relevance from that which has already lost relevance**. It is clearly wrong and we might neglect the situation where it is far from a scientific situation for a long time.

labor hour. Typically, this fully burdened cost center labor rate was at least four times the actual direct labor rate paid to workers. In some highly automated cost centers, it was not usual for the rate to be ten or even fifteen and twenty times the hourly labor rate.” (Johnson, H. T., and R. S. Kaplan, 1987 p.184)

2.2.2. “Illogical Inventory Measurements”

Increasing the capacity utilization, more products can be produced and the cost per unit is reduced (or so it might appear). It should not be overlooked that the inventory is considered as assets in the financial statements even if it cannot be sold. The profit will increase because the manufacturing cost is reduced while assets are increased.

Treating inventory as assets was not an issue long ago. When the market environment was in short supply, in the other words, everything that had been produced could be sold, inventory *was* an asset. However, supply shortages were resolved by mass production technology coupled with Gemba Kaizen activities driven by industrial engineering, lean and etc. Where product life cycles became shorter and shorter in the competitive environment, it became a major risk to have inventories that might not be sold.

Taiichi Ohno, the author of *Toyota Production System*, is recognized to change production worldwide. He said³:

“If they don’t know how they are contributing to the overall performance or operations, they often end up producing as much as possible. This makes a company poor.” (Ohno, 1984)

Dr. Goldratt, the author of the best seller *The Goal* who admired Taiichi Ohno as “my hero”, talked about Ohno’s great achievement as follows:

“Everybody at that time in the world thought that inventory is an asset. It’s totally contributed

to Ohno that he changed this concept that inventory is not an asset. It’s a liability. He succeeded to change it worldwide except one place, your balance sheet where inventory still stupidly appears under assets.” (Goldratt 2009)

It is common sense that reducing inventory in which you make the flow of work faster and produce only necessary products as needed, will reduce stagnation of money tied up in inventory and thus will bring profit faster. Therefore, reducing inventory is naturally perceived as good, while it is perceived as bad in the financial statements because inventory is considered an asset, not a liability.

Doing good things perceived as doing bad things generates distortion in Gemba. Dr. Takahiro Fujimoto of The University of Tokyo points out this situation as follows:

“It is commonly known that cost accounting people and production people are not in good terms. Toyota Production System, which aims for small-batch production, work-in-process reduction and shorter production lead time, is especially known to be incompatible with traditional cost accounting. In fact, the strained relationship is well known between Mr. Ohno, vice president in production, and Mr. Hanai, vice president in accounting in Toyota.” (Fujimoto, 2006)

The conflict lies in the difference between considering unnecessary inventory as a liability or asset. It is obvious that accountants have no bad intention; they simply follow the fiscal rules. The outdated fiscal rule that considering

³ Quoted from Taiichi Ohno’s lecture, “Implementing IE (Industrial Engineering) to Make Money” (Nov29,1984). This lecture can be seen at the Website

of The Japan Institute of Industrial Engineering.
<http://www.j-ie.com/information/post-5198/>

inventory as assets is causing conflict between accounting and production.

The learning here is that the relevance was lost to consider inventory as asset. Where the circumstance you can sell everything you make has changed, considering inventory as assets is illogical and we might neglect the situation where it is far from scientific situation for a long time.

It is obvious that evaluation by two illogical measurements which are “illogical manufacturing cost measurement” and “illogical inventory measurement” are causing illogical behaviors. Unless those illogical measurements are corrected, those illogical behaviors cannot be eliminated.

3. Throughput Accounting

3.1 Misunderstanding of Throughput Accounting

In order to correct these illogical measurements, Dr. Goldratt developed “Throughput Accounting”. He claimed as follows:

“The goal of a company is to make money, now as well as in the future.”(Goldratt, 1984)

Also, Nampachi Hayashi, ex-fellow of Toyota and one of the last direct students of Taiichi Ohno, the author of *Toyota Production System*, commented on “Genka Teigen (generally translated as cost reduction)” as follows:

“Genka Teigen does not mean buying things cheaper. It means manufacturing things with less cost to make money. Cost reduction is mistranslation; it should be translated as Making Money in Process.”(Hayashi, 2018)

What is the right measurement for decision-making when making more money is an objective? Throughput Accounting was developed to answer this question.

Dr. Goldratt defined Throughput as follows:

“The rate at which the system generates money through sales”(Goldratt, 1990)

There are two distinctive features of Throughput Accounting:

- Does not count till sales are made.
- Does not allocate.

In other words, fixed cost is managed separately as operating expense. Thus, it makes calculation very simple. Throughput is calculated by subtracting variable cost from sales, which can be used as a simple measurement for making more money.

However, you might have a question, how can fixed cost be retrieved without allocating it to each product? There is a simple solution: If you make management decisions to make more throughput faster, then the company will make more throughput faster. Then, it is obvious that the company can retrieve fixed cost faster. **Fixed cost is retrieved because a company makes more money, not because it is allocated.**

Throughput Accounting has been applied to various companies all over the world where it has been achieving breakthrough results. On the other hand, some view Throughput Accounting as just another version of direct cost accounting because the amount in which variable cost is subtracted from sales is generally called “marginal profit”; it has been used for ages in traditional accounting, and thus some criticize that it is not a new concept.

However, Throughput Accounting has another

distinctive feature which was not so clearly verbalized in the past. It is **based on the assumption in which “throughput of a system is regulated by the constraint.”**

3.2 Holistic Management Theory: TOC

In 1984, *The Goal* (Goldratt 1984) was published and today it still remains on the best seller list throughout the world. In the book, Dr. Goldratt introduced Theory of Constraints (TOC), a holistic management theory. Think about the following questions to understand the general idea of TOC:

1. Is your work independent from other employees or the organization?
2. Are the capacities of each employees or organization the same?

You and other employees would answer no to both of these questions. Why? Because there are “interdependencies” and “variability” in most organization’s activities.

If you look at the flow of work in organizations, for example in the links from customers to sales to design to production to logistics to customers, you probably would conclude that it is impossible for each link to have exactly the same capacity.⁴ Figure 1 shows a model of an organization where there are “interdependency” and “variability” in resource capacity.

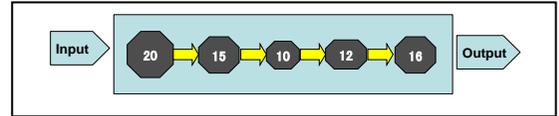


Figure 1: System with “interdependency” and “variability” (Kishira, 2017)

Work flows across each station (work centers, departments, etc.) from left to right, but capacity for each station varies as follows: 20, 15, 10, 12 and 16 per day. How much is the daily output of this system (company, organization)? It is obvious that the daily output cannot exceed 10 units which is the bottleneck (the constraint).

It is obvious that where there are interdependencies and variability, there must be a constraint⁵ somewhere. Focusing on improving the constraint brings results to the whole. In short, performance as a system is determined by the constraint.

According to the Oxford English Dictionary, system (System, 2017) is defined as: “A set of things working together as parts of a mechanism or an interconnecting network; a complex whole.” Therefore, recognizing an organization as a system composed of multiple elements rather than one whole element is not just obvious but also important. For this reason, assuming there are both “interdependencies” and “variability”, we can focus on the bottleneck for holistic improvement of an organization. As the application of TOC expanded to other environments, the word “bottleneck” was

⁴ Note also, rarely is production a bottleneck in the workflow of a company. When you can sell as much as you produce, your bottleneck is production so you get bottom-line results by improving the production bottleneck; however, if limited opportunities to receive customers’ orders were a bottleneck then sales is the bottleneck; it should be obvious that it is difficult to get bottom-line results as a company by improving production when it is a non-bottleneck.

⁵ To bring results by focusing on the constraint, Dr. Goldratt developed a process called the 5 Focusing Steps. The steps are as follows: 1) Identify the constraint(s), 2) Decide how to exploit the constraint(s), 3) Subordinate everything else to the above decisions, 4) Elevate the constraint and 5) Warning!!! Do not let inertia become the constraint. When a constraint is broken, go back to Step 1.

misunderstood and inappropriate; thus, Dr. Goldratt carefully selected the word “constraint” instead ⁶ and developed the “Theory of Constraints” - focusing on the constraint is the foundation for holistic management to achieve significant bottom-line results rapidly.

3.3 Flow of Work and Flow of Money

Here, we would like to discuss an insight regarding the flow of work and the flow of money. There is a flow of money in any business operation. Figure 2 shows the process where capital is invested in business activities turning into cash returned, retrieved through those business activities in financial statement.

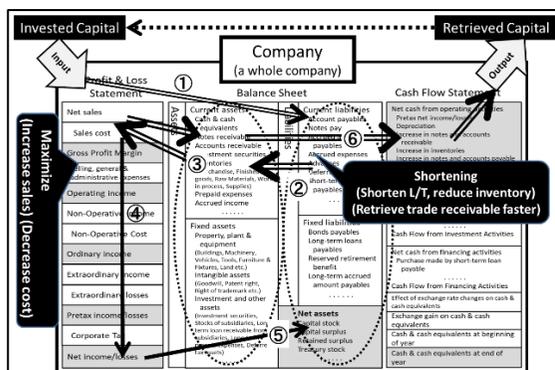


Figure 2: Flow of Money on Financial Statement (Hiiragi, 2019)

Arrow (1) shows the flow of invested capital, which becomes an asset through various business activities indicated as Arrow (2). Arrow (3) then shows those assets turning into sales by utilizing assets. From here, the flow of money branches into two different flows with different purposes. The first flow is shown as Arrow (4) in which the calculation of profits and losses is done by subtracting outgoing money from incoming money.

⁶ Dr. Goldratt explains the reason why he changed the word 'bottleneck' to 'constraint' in his article “What is

The bottom is the current term net income, which means the amount of money increased during this fiscal period or the amount of new money coming from outside of a company during this fiscal period. This money is used for stockholder dividends or it goes into the company’s internal reserves. This flow is indicated by Arrow (5). Another flow is related to the cash flow statement. The money is initially called “inventory assets” before sales but after sales, it will come back to the same spot on balance sheet under the name of such as “accounts receivable” or “bills receivable”. In both cases, the money has become cash only when it is eventually collected, which is shown by arrow (6).

Now, consider the following question:

“Is there interdependency and variability in the flow of work in a system called a company which has flow of money?”

If interdependency and variability exist in the flow of work of a system called a company, it is valid to say that performance as a system is regulated by the constraint.

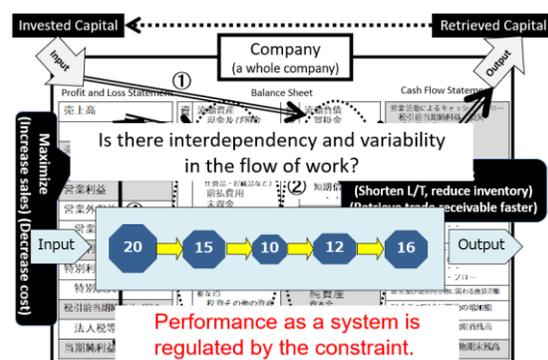


Figure 3: Overlapping Flow of Work on Flow of Money (overlapping Kishira 2017 on Hiiragi 2019)

TOC?”. This article is available in “Theory of Constraints handbook” MacGraw-Hill.

This means that Throughput Accounting has not only two features described previously, but three:

- Does not count till sales are made.
- Does not allocate.
- **There is a premise that performance as a system is regulated by the constraint.**

Since Throughput Accounting has a premise that “performance as a system is regulated by the constraint”, it might be better to call it as “TOC” Throughput Accounting, instead of just Throughput Accounting in order to avoid misunderstanding.

3.4 System with a Constraint in the Flow

In a fluid system, it is common to control the total output by a constraint called a regulator. This means that it is possible to control the total output by managing the constraint. Considering that a company is a system with a constraint in the flow of work, it is possible to claim that **a system called a company is also a fluid system.**

Performance of a system called a company is regulated by the constraint. If so, it is reasonable to claim that total output can be increased or decreased by managing the constraint. TOC Throughput Accounting takes a company as a fluid system with a constraint. Thus, **TOC Throughput Accounting is a Fluid Dynamic Accounting to dynamically manage a company’s flow of work and its flow of money.**

It is clear now why Dr. Goldratt adopted the word “throughput”, not “marginal profit”; that is, **the word throughput has an implication of “capacity regulated by the constraint.”**

3.5 Formula to Consider the Constraint of Flow as Regulator

Assuming that a company is a fluid system with flow of work and flow of money, it means that the constraint of the system can be seen as a regulator that can **increase or decrease output of a system by managing the constraint.**

The formula can be expressed as follows:

$So = Cmag \cdot S$ <p>“So” is sales output of a whole system “Cmag” is constraint magnification of the constraint capacity “S” is current sales This formula is valid only when applied to the constraint</p>
--

(Kishira, 2019)

It becomes evident that now **it is possible to simply calculate how much money you can make by the magnification of constraint capacity.** In other words, **it is possible to easily predict with a number the potential for breakthrough of a company.**

3.6 Managing Throughput at the Constraint

Below summarizes what has been revealed so far:

- In a system where there is interdependency and variability, there must be a constraint somewhere
- Output of a system can be predicted by managing the constraint

In other words, **in a system with interdependency and variability, an increase or decrease of total throughput can be predicted when considering the increase or decrease of the**

throughput through the constraint.

The past cannot be changed, but the future can be changed. It is far better to spend precious and limited management attention to the future which can be changed, not to the past which cannot be changed. In this sense, it is more effective for management to focus on the changeable future by thinking about increasing or decreasing the throughput by managing the constraint.

3.7 The Constraint in the Flow of Work in a Company That Has Kaizen in Production

Let's examine the constraint in the flow of work in a company as a system. Production is now rarely a constraint in the flow of work in most companies because of productivity improvement activities like Industrial Engineering (IE), Lean, etc.

In fact, when looking at the flow of work in any company, the constraint is often identified as the human resource such as experienced, capable personnel that cannot be increased easily.



Figure 4: A Case Where the Constraint is Not in Production

Can you increase excellent personnel right away? Here it is getting obvious that **the resource that cannot be increased easily tends to become the constraint, even if people knew it as a**

⁷ Needless to say, it is people who do the work. It is impossible to improve the quality of work when they are continually overwhelmed with work. It is obvious that lowering the quality of work of the constraint in an organization affects the performance of the whole

bottleneck for years.

The resource that cannot be increased easily is, in other words, a scarce resource. If you examine the work content of a scarce resource (e.g. experienced capable personnel), you will find out that he/she most likely does not always focus on what only he/she can do. Not only that, the reality is that he/she tends to become busy with other tasks because everybody relies on him/her knowing his/her capability⁷.

Assuming you are the constraint of your company, answer the following question:

How much time in a day do you focus on what only you can do?

When you try to answer above question, you will find that it is quite seldom that the scarce resource (the constraint) is fully performing to its potential. If you find the constraint, your Kaizen approach would be totally different. You just need to focus on improving the constraint. By all employees focusing on supporting and improving the constraint, significant bottom-line results should come faster, and your focused Kaizen would be more effective than the current approach - trying to improve everything. In short, you can get bottom-line results⁸ easier and faster.

For example, list every task of a scarce resource such as an experienced design engineer and ask somebody else to do the work that he/she does not need to do by himself/herself. Then, the design engineer is released from the situation where he/she was filled with various tasks every day. He/She can now have some buffer in his/her time

organization.

⁸ It is not rare that when people understand the overall performance will improve if their attention is on a certain point, then they start to help each other. I have seen this happen in many companies.

and focus on single task each time. It is obvious that his/her productivity will increase.

Let's assume that the time which the constraint resource can focus on his/her work is increased by 20%⁹. This means that there is 20% more of the constraint resource. Consequently, the total output will also increase by 20%.

This financial impact is enormous. Take for instance, a 10-billion-yen sales company with 1% profitability (100-million-yen). In this case, the calculation of the sales (output) increase brought through increasing the constraint capacity can be calculated as follows:

$$S_o = C_{mag} \cdot S$$

$$S_o = 1.2 \times 10\text{-billion-yen} = 12\text{-billion-yen}$$

Increase of the constraint resource by 20% means that the total performance will also increase by 20%. In this specific case, sales increased from 10-billion-yen to 12-billion-yen. If variable cost is half of sales (which means marginal profit ratio is 50%) and 2-billion-yen is the amount of increased sales, throughput increased by increasing the constraint capacity can be calculated as follows:

$$2\text{-billion-yen} \times 0.5 = 1\text{-billion-yen}$$

Increase or decrease in throughput of the constraint in a system with interdependency and variability is equivalent to increase or decrease in the total throughput. Therefore, 1-billion-yen is added to profit and the company with 1% profitability (100-million-yen) becomes a company with almost 10% profitability (1,100-million-yen) with 12-billion-yen in sales.

How would your actions change if you realize

⁹ 20% improvement here is quite a modest estimation; because usually, the scarce, constrained resources are so capable that they are often overwhelmed with tasks.

that you can get breakthrough result by just helping the constraint?

What will happen to everyone's bonus if total profit goes up significantly? How will you be evaluated as a person who has contributed greatly to increase the total profit? Is your behavior holistic or silo? How would the person who was helped feel?

People will start helping each other without being forced to, just by knowing the constraint in the system. From that moment on, conflicts in an organization will disappear and holistic harmony will start spreading all over the organization. This is simply **a result of rational behavior caused by rational measurement.**

3.7 Cost Reduction Without Considering the Constraint

Now, we would like to come back to the initial question asked in this article, "Does a Company Make More Money if Cost is Reduced?"

It seems logical that the profit will increase because costs go down; however, the reality is that profit sometimes decreases by cost reduction. There must be a pitfall in the statement that says, "Cost reduction will increase profit". What is the pitfall?

When you calculate how much profit you can make by cost reduction, you probably assume that the sales will remain the same. Is this assumption right?

Take the example of the 10-billion-yen sales company with profit of 100-million-yen. If they did 10% cost reduction in all departments without any exceptions, the constraint capacity also will be decreased to 90%. In this case, sales (output) are calculated as follows:

Once they can focus, it is not rare that their productivity to easily double.

$$S_o = C_{mag} \cdot S$$

$$S_o = 0.9 \times 10\text{-billion-yen} = 9\text{-billion-yen}$$

If you reduce the capacity of the constraint, the assumption that the sales will remain the same would not stand anymore. For the company, the damage of sales decreasing to 9-billion-yen is massive. If variable cost is a half of the sales, marginal profit of 500-million-yen is lost by losing 1-billion-yen of sales. Increase or decrease of throughput of the constraint in a system with interdependency and variability is equivalent to increase or decrease in total throughput; therefore, this 500-million-yen loss means total loss to the company. Subtracting this 500-million-yen from the current 100-million-yen profit, the company will have a total loss of 400-million-yen.

Now it is quite obvious that **Cost reduction without considering the constraint could cause a company a huge loss**¹⁰. The following are examples of cost reduction that could jeopardize a company:

- Cost reduction that directly reduces the capacity of the constraint
- Cost reduction that affects in reducing the capacity of the constraint
- Cost reduction that wastes the capacity of the constraint

When excellent personnel are the constrained resource, the damage is even more severe. Those excellent personnel are usually scarce resources in the industry as well, so they are in great

demand. **If those scarce resource go to a competitor, it could not only jeopardize the company's present and future but also give advantage to the competitor.**

The contrary is also true. **If a company could utilize the scarce resource much better than the industrial standard, the company may gain a decisive competitive edge.**

3.8 Decision Making that Focuses on the Constraint

One of the most important tasks for management is decision making. Management is always facing to answer the following questions:

- Which product to produce to make more money?
- Which inquiries to prioritize?
- Produce in-house or outsource?
- Invest or not?

The quality and speed of decision making will be totally different if the constraint is in consideration or not. The following must be examined if the constraint is in consideration:

- Which product to produce to make more money?
 - ➔ Examine throughput per constraint expended hour
- Which inquiries to prioritize?
 - ➔ Examine throughput per constraint expended hour
- In-house or outside to produce?
 - ➔ Examine if the current constraint

¹⁰ A pitfall of overseas production with lower cost is prolonged lead time—this leads to more unnecessary inventory. Furthermore, longer lead time will make forecasting even harder, which also leads to an increase in inventory. It is equal to allowing the constrained resource to make an unnecessary amount

and wasting their capacity. In a fiercely competitive environment with rapid price-reductions, high inventory would force them to discount or incur more sales promotion cost, which results in serious damage to the company.

capacity is exploited

- Invest or not?
 - Examine return on investment at the constraint

The calculation becomes much simpler since there is only the need to consider the constraint. It is an advantage of TOC Throughput Accounting that you will **be able to make decisions without depending on the numbers that only accounting experts can calculate.**

4. For Accounting to Gain the Position as a Scientific Theory

Karl Popper tried to answer the question, “When should a theory be ranked as scientific?” Popper claimed, “the criterion is its refutability (risky prediction) or testability.” (Popper 1953)

His claim is reflected in *Kojien*, the most popular dictionary in Japan. When looking up the definition for the word “theory” in *Kojien*, the definition of theory has been changed recently. In the 5th edition (1998), the meaning of theory was “universal systematic knowledge that can explain an individual fact or recognition uniformly”; in the 6th edition (2008), it is “universal systematic knowledge that can explain and predict individual fact or recognition uniformly in science”.

With the definition of 5th edition, theory can be established when you can explain what happened before; however, in the 6th edition theory is defined as “universal systematic knowledge that can predict... in science”. Thus, **it is not considered theory in science just to be able to explain something after it occurred. Theory in science must be systematic knowledge that can be**

used to predict.

However, we must be careful to dismiss theories as useless even if they might not yet be ranked as “scientific”. Many theories and methods that are widely known and supported in social science are useful to society but have not attained logical predictability to the extent of hard science. It can be significant for theories and methods in the social sciences in the world to attain “scientific” status.

In this sense, the following two conditions must be met for theories in the field of accounting to be ranked as “scientific”.

- The capability of risky prediction
- The capability of validation

The word hypothesis is defined as, “supposition made to explain a certain phenomenon uniformly in hard science and other area”, according to the *Kojien* dictionary. By verifying a logically derived outcome through observation, calculation, experiment, etc., supposition becomes valid law or theory in a certain limitation.”

A hypothesis is still just a hypothesis. Popper claimed that scientific theory will never be established as a perfect theory but will always be in a position of a ‘tentative hypothesis.’ However, there is an exceptional value in the scientific theories that have been surviving for years through many refutations (Noe 2015).¹¹

In this sense, TOC developed by Dr. Goldratt has been verified in various fields and has survived till now, and therefore it may be a valid theory within a certain limitation, which is, “system with interdependency and variability.”

TOC Throughput Accounting is an accounting

¹¹ Quoted from “Invitation to Philosophy of Science” by

Keiichi Noe (Chikumashobo Ltd.)

method based on TOC, a scientific theory.

5. Case Study

5.1 Environment of the Subject Company

By considering a company as a system, releasing more capacity of the constraint in the flow of works will allow flow of money to get faster, and will lead to better bottom line performance. Now, we would like to share a case study that TOC Throughput Accounting was applied to.

The subject company is UNIFLOW Co., Ltd. which develops, produces, sells and installs doors and shutters for industrial use. The company was founded by Koji Uno in 1965, by the father of the current CEO Sayumi Ishibashi. The company is a leading manufacturer of swing doors which are often seen in supermarkets.



Major Products of Uniflow
(data provided by Uniflow)

At the time, the company was struggling with poor performance. Acquisitions of construction permits were taking longer because of the scandal that happened in 2005 regarding the earthquake building regulations. This directly affected the company’s sales. In addition, the economic

downturn precipitated by the bankruptcy of Lehman Brothers made it worse. In 2007, the CEO at that time suddenly stepped down, and Sayumi Ishibashi became the new CEO as requested by many employees. Her wish was to protect the company her father founded.

In an effort to handle the situation, the company hired accounting experts from a large enterprise. They analyzed the business to make more profit. As a result, they decided to focus on swing doors, which had high marginal profit ratio, along with cost reduction activities to improve the company performance. However, the performance remained very poor or even worse.

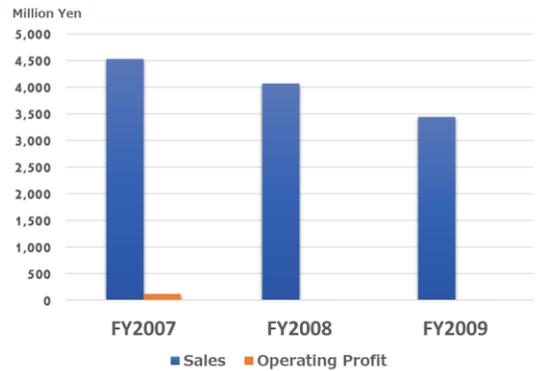


Figure 6: Performance Trend around 2009

To emerge out of this critical situation, in 2010, the company started to utilize TOC Throughput Accounting in which they focused on the constraint in the flow of work to make flow of money faster. Looking back on those days, Ms. Ishibashi commented as follows:

“Ever since I got married, I had been a housewife. I didn’t have work experience. Although I studied Marketing in a university in the U.S., I had no knowledge about business management. What I discovered from learning TOC Throughput Accounting is that the goal of a company is in

making money (in UNIFLOW, they call “cha-ching”) after all. If the company makes more money, employees will get more salary and the company can invest in new product development. So, I explained to the employees, ‘let’s focus on making more money by cha-ching!’.”

5.2 What is the Constraint in the Flow of Work?

When they analyzed the flow of work, Uniflow found out that designing was the constraint. In general, designing often becomes a key to get orders in the companies which manufacture make-to-order products requiring individual customization. In many cases, clients do not necessarily have expertise to design what they need, so they rely on suppliers. So, for make-to-design companies, it is common that the experienced design resource becomes the constraint.

They used TOC Throughput Accounting to examine their major products: Products A, B and C.

For Product A, the selling price was 100,000 yen. Variable cost, which goes out of the company, was 50,000 yen, so the marginal profit ratio was 50%. For Products B and C, selling price was 25,000 yen each. Variable cost was 20,000 yen each, so the marginal profit ratio was 20% each¹². Compared to competitive Product A consisting of proprietary know-hows, Product B and C were commodities that many can produce; thus, profitability was much lower. It seemed natural to focus on getting more orders for Product A in order to increase their profitability.

However, when considering the load on the constrained design resource, the situation was contrary. Product A placed a high load on the

constraint. On the other hand, Products B and C did not require so much load even when multiple orders came in. Moreover, they found out that Products B and C were a necessity for Product A, so they could get orders simultaneously when Product A was sold.

	Contract Amount	Variable Cost	Marginal Profit Ratio	Load on Designing
A	100,000 yen	50,000 yen	50%	High
B	25,000 yen	20,000 yen	20%	Low
C	25,000 yen	20,000 yen	20%	Low

Table 2: Marginal Profit Ratio and Load on the Constraint

In other words, they could increase sales to 1.5 times by just getting orders of Products B and C when they got orders for Product A.

$$So = C_{mag} \cdot S$$

$$So = 1.5 \times 3\text{-billion-yen} = 4.5\text{-billion-yen}$$

At that time, sales was 3-billion-yen, so with this new policy, sales was predicted to hit 4.5-billion-yen.

Marginal profit ratio is 20% for increased sales of 1.5-billion-yen. In brief, profit of 300-million-yen (“cha-ching” in UNIFLOW) came into the company. This became the source of employees’ bonus and future investment.

Ms. Ishibashi made a major shift from a profit ratio focus to “cha-ching!” focus in business decision making. Looking back, she commented:

“I always felt uncomfortable with the word ‘profit ratio’ as a housewife who managed the family budget. I had never even heard of it. But the idea of making more money ‘cha-ching!’ into a wallet is intuitive for anyone, so it didn’t take so much time to penetrate the *Gemba*.”

given as reference.

¹² Actual figures are confidential, thus these figures are

Also, sales people commented that, “Getting orders for Products A, B and C all at once will save time for the customers as well. It improves service and eventually develops a good reputation, so it makes it easier to get next orders. Getting orders all at once is a little time-consuming for us, but we think we can provide more value than its price.” As expected, the company’s reputation went up and became famous in the industry.

They were worried that the order increase could increase the load of design resource, the constraint, so they analyzed their work. There were so many tasks such as inquiry response, quotations, specification evaluation, design, dealing with inquiries from Gemba, design modification, and cost reduction activities where not all of them required design resource. They realized that people in other departments could help the tasks that did not require special skills. It became clear that they could still take more orders knowing they could dramatically increase capacity of the design resource if they focus on the primary tasks.

Designers commented, “We thought we were overloaded with just daily tasks, but everybody helped us create more time for us. By using time generated, we want to develop a new product that makes more money with more added value.”

The following figure shows the increase of sales and profit. In 2016, compared to 2010, the company had a 69% increase in sales; operating profit ratio went up from 0.5% to 12%; operating profit reached 24 times more. The result of forgetting profit ratio and focusing on increasing the “cha-ching!” proved to be successful.

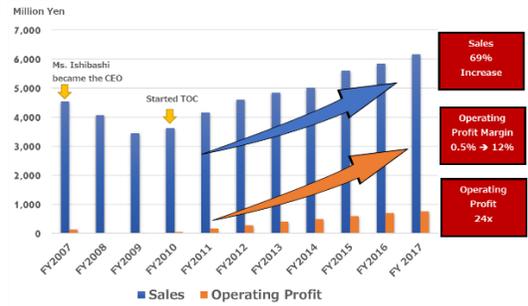


Figure 7: Performance Improvement of Uniflow

In addition, the company started to develop a new product, condensation-free and fire-prevention doors for food processing plants which are getting popular in their clients too.

Ms. Ishibashi commented as follows:

“The most rewarding thing was in people’s growth. I am pleased with people who can support our future growth. We are building a culture that everybody helps the constraint in order to get more ‘cha-ching!’ I cannot wait to see our company grow more.”

6. Summary – To Make Management Accounting as Hard Science

The claim made in this article is that, “In a system with interdependency and variability, increase or decrease of total throughput can be predicted when considering the increase or decrease of throughput at the constraint”. With this, the management should keep the following in mind:

- **Focus on increasing the throughput of the constraint**
- **Non-constraint can contribute to the whole by helping the constraint**
- **Weakening the capacity of the constraint**

jeopardizes competitiveness of a company now and into the future

- **Don't do cost reduction efforts that do not contribute to throughput increase**
- **When investing, prioritize capacity increases on the constraint that contributes to throughput increases**
- **Focus on the future that can be changed, not on the past that cannot be changed**

Note however, that the above claims are only valid in a condition where a system with interdependency and variability exist. If it is the case, results as a whole can be realized by focusing on increasing the throughput through the constraint.

As mentioned previously, scientific theory will never be established as a perfect theory, but it will always be in the position of a 'tentative hypothesis.' This article is also a tentative hypothesis, but still, it can be practically effective for many organizations with interdependency and variability to improve their performance.

Juichi Yamagiwa, the president of Kyoto University, points out that the power of science has two aspects:

1. Finding better answers to a given problem within limited time.
2. Ability to create a new theory or perspective by turning over common sense with a brand new idea.

The authors hope this article will be a help to evolve management accounting to be ranked as scientific status by going through various validations.

Acknowledgement

We would like to thank Mr. Nampachi Hayashi, ex-fellow and a board member of Toyota Motor

Corporation, Yasuyuki Kazusa Ph.D., honorary professor at Kyoto University, Katsuhiro Nishinari Ph. D., professor at Research Center for Advanced Science and Technology in The University of Tokyo, Michiyasu Nakajima MBA, dean and professor of commerce at Kansai University, members of Management Science Association, and members of Goldratt Japan for giving us enormous help and guidance to write this article.

References

- Goldratt, E: *The Haystack Syndrome*, North River Press 1990.
- Goldratt, E: *The Goal: A Process of Ongoing Improvement* North River Press 1984.
- Johnson, H. T., and R. S. Kaplan: *Relevance Lost*, Harvard Business School Press 1987.
- Popper, K: *Science: Conjectures and refutations* 1957.
- Ono T: "Practice of IE to Make Money" Video recorded in November 29, 1984 (Japanese).
- Kishira, Y: TOC (Theory of Constraints) as scientific theory - "Structure of hypothesis" to define scientific theory and a possibility for better society *IE Review* Vol. 58 No. 3 2017. 8
- "I want to protect the company my father founded" *Chichi* October edition, 2016 (Japanese).
- Kojien* 5th and 6th edition (Japanese).
- Goldratt, E: "The Choice for Ever-flourishing" Video recorded in April 20, 2009.
- Goldratt Journal Vol 2 Case Study UNIFLOW Co., Ltd. 2018 goldrattjournal.com (Japanese).
- Noe K: "Invitation to Philosophy of Science" Chikumashobo Ltd. 2015 (Japanese).
- Hayashi N: "The Essence of Toyota Production System" Goldratt Conference Keynote Speech Video Recorded in September 27, 2018.
- Hiiragi S. "Maximizing Investment Capital

Recovery and Shortening the Recovery Period"
AIT The Review of Business Administration and
Computer Science, Vol.13 No.2, 2019

Fujimoto T: "Cost Management from Viewpoint of
Manufacturing" MMRC at The University of
Tokyo *Discussion Paper* No.93 2006 (Japanese).

Yamagiwa J: *Warning from Gorillas* Mainichi
Publishing, 2018 pp108-109 (Japanese).

About Authors

Yuji Kishira

Goldratt Japan, CEO. As an author, speaker and change management leader, Yuji Kishira has been supporting holistic management transformation in various industries and government organizations. One of his works, "Win-Win-Win public work reform" was adopted by the Ministry of Land, Infrastructure, Transport and Tourism as well as by many prefectural, city Governments all over the Japan in April of 2007. Yuji started work together with Dr. Goldratt in April of 2008 as a director of Goldratt Consulting He is involved in various big companies implementing holistic change initiatives to become ever-flouring companies. He is known as one of the people that gave a major influence to Dr. Goldratt's thinking. Adjunct professor at Tokyo University MMRC, Adjunct professor at the College of Land, Infrastructure, Transport and Tourism.

Kojiro Tobita

Goldratt Japan, Partner.

In 1974, joined Tateishi Electronic Company (present Omron Inc.) Served as the chief of Industrial Control Component Department, CEO of Omron Europe, and the Chief of Manufacturing Innovation HQ. In 2010, retired Omron as the Managing Executive Officer and joined Goldratt Japan to share its mission to disseminate TOC all

over Japan. Affiliate Professor of Osaka Institute of Technology since 2012.

Shino Hiiragi

Associate Professor, Aichi Institute of Technology, Faculty of Business. PhD. Management Information Science

Her mission is to bridge a gap between Product Management (Gemba Kaizen) and Management Accounting (Corporate Performance). Studied Accounting while working for OJT Solutions Inc., a consolidated subsidiary of TOYOTA, where she pursued Gemba Kaizen (Work process improvement) and resource development.

Recently she has written "Visualize the effect of Kaizen: GKC "6 Steps to Improvement" (Chuo Keizai)