

Risk Management of Materials Supply on the Example of Tube Works

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Abstract

The article is devoted a risk management in the business process of materials supply for industrial enterprise.

The goals of the business process are considered and the risks of unachievement of goals are identified. Probabilities and influence of negative events are estimated. The risk treatment is considered on critical risks, including forming of insurance supplies of materials. The calculations of insurance supplies of materials taking into account risks are conducted on the basis of statistical information.

Keywords: goals of business process, identification of risks, estimation of risks, measures of mitigation, insurance inventory.

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One of tasks of effective control of inventories — to «satisfy or exceed expectations of buyers in regard to the presence of commodities»

... on the other hand, it is needed to remember - «effective control of inventories allows organizations to create such supplies of every commodity, which maximize a net income».

John Shraybfeder,
president of company Effective Inventory Management, Inc.

In the unbroken chain of business process the purpose of which is a sale of commodities to clients, the process of supplying with materials is played an important role[1].

Therefore as one of strategic goals of company there must be a trouble-free supply materials of the required quality on condition of rational cost of supplies.

Continuity guarantees the presence of the commodities on storage, quality of materials provides quality of products and acceptable losses from defective goods, the rational cost of supplies prevents «freezing» of company finances.

Thus, the purposes of supply of materials can formulate as follows:

- providing of terms of deliveries;
- providing of the required quality of materials;
- providing of rational volume of delivery.

The factors influencing on achievement of the purposes listed above, can be the followings:

- stability of material properties;
- discipline of shipping of materials a supplier;
- implementation of terms of materials delivery a transport company;
- observance of norms at unloading and warehousing of materials;
- observance of norms at preparation of materials for a production;
- quality of planning of orders is in a company;
- stability of producing goods.

Risk management from the moment of determination of strategic goals of company supposes step-by-step fulfillment of actions which are based on simple (it is possible to say everyday) logic – to identify risks, to estimate importance, to develop the sufficient measures of mitigating risks, to realize measures, to take risks under control.

Such logic is traced in all of the known regulating documents in area of risk management [2-5].

This process is reasonable to risk management of business process of materials supply. After forming of strategic goals it is necessary to expose risks.

The risks of unachievement of the goals mentioned above are following:

- insufficient quality of materials from instability of production by supplier;
- incomplete deliveries of materials through fault of supplier and stealing at transporting;
- delays of shipping a supplier;
- delays at transporting;
- delays at unloading and warehousing through fault of personnel and because of disrepair of equipment;
- delay at preparation of materials through fault of personnel and because of disrepair of equipment;
- increase of amount and volume of orders as compared to planned;
- unevenness of production because of repair works and planning of loading equipment.

Estimation of risks, inherent in the business process, is conducted on the basis of expert and statistical information (table 1).

Table 1. Estimation of inherent risks

№	Risk name	Probability, %	Influence (delay of production output), day	Weighted estimation, day	Rank of risk
1	Insufficient quality and incomplete deliveries of materials through fault of supplier	20%	0,05	0,01	6
2	Delays of shipping	10%	1	0,1	3
3	Delays of transporting	20%	1,5	0,3	1
4	Delays at unloading and warehousing	30%	0,08	0,024	5
5	Delay at preparation of materials	30%	0,03	0,009	7
6	Increase of amount and volume of orders	80%	0,26	0,208	2
7	Unevenness of production	50%	0,15	0,075	4

At setting of risk appetite at the level of 6 numbers, that corresponds 0,15 days of delay of supplying with materials or dead time of equipment, three risks are estimated as risks high level, requiring reacting the company management.

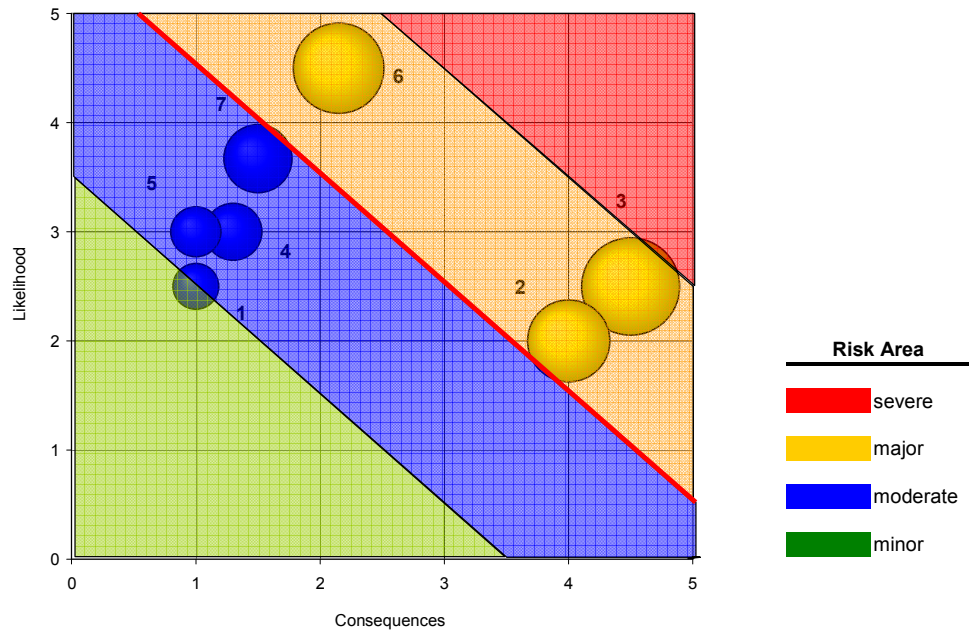


Fig. 1. The map of inherent risks

Some part of risks, because they are external (supplier, carrier company, client), can not be removed in principle.

Internal risks are a personnel (worker, repair, administrative), equipment, organization of the business process – managed in a greater degree. A limit on efficiency of risk treatment, mainly, is financial. But it does not eliminate the residual risks of anthropogenic character.

Risk treatment includes followings.

Insufficient quality of materials, incomplete deliveries:

- choice of reliable supplier, diversification of suppliers;
- creation of insurance inventory of materials.

Slower delivery of materials:

- choice of reliable supplier, diversification of suppliers;
- choice of reliable carrier companies, diversification of carrier companies;
- selection of skilled personnel, motivation;
- prophylactic and current repair of equipment;
- creation of insurance inventory of materials.

Uneffective planning of orders and unevenness of production:

- optimization of purchase parties of materials;
- observance of regulation of products planning;
- work with a client for planning of orders;
- prophylactic and current repair of equipment;
- creation of insurance inventory of materials.

On fig.2 the risk map is resulted without the account of creation of insurance inventory of materials. This measure will be used for uneffectiveness of the realized measures of mitigation of risks.

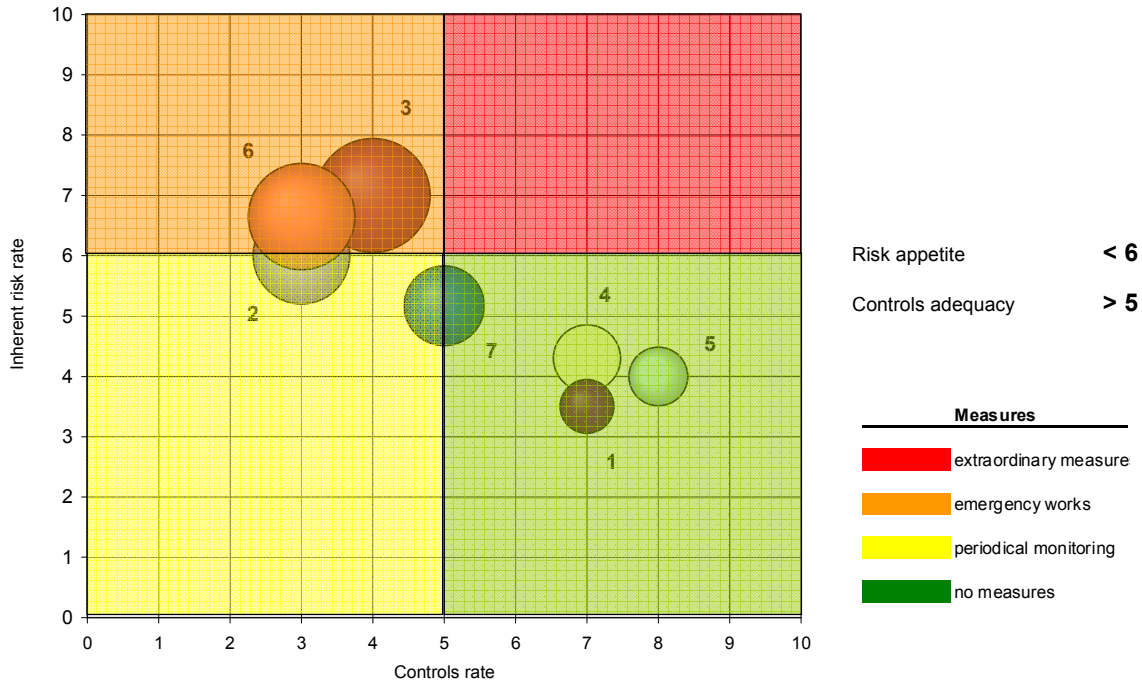


Fig.2. The map of risks (without the insurance inventory)

As follows from fig.2, realized measures it is not enough, to reduce risks to the acceptable level.

By the measure high level, which can compensate risks, creation of insurance inventory of materials can be examined. Limit on efficiency of this measure, only financial.

Traditionally inventory of materials is settled 50% from the level of current inventory, here not stipulating probability of coverage of deficit of materials. Taking into account instability of market relations supplier-producer and producer-client, it is expedient to ground an insurance inventory for any large company, taking into account its concrete features.

For pipe factories the insurance supply of material in general case can be expected on the following formula:

$$T_{insur}(day) = \Delta T_{deliv}(day) + \Delta T_{transp}(day) + \Delta T_{unload}(day) + \Delta T_{prepar}(day) + (\Delta Q_{deliv} + \Delta Q_{plan} + \Delta Q_{prod}) / R^{aver} use(ton / day);$$

where

ΔT - positive deviation from the mean values of duration of subprocesses of materials delivery;

ΔQ - a shortage of material through fault of supplier, because of receipt of new orders and unevenness of production;

$R^{aver} use(ton/day)$ - the average daily use of material during a month.

It is suggested to consider as estimations of insurance inventory:

1. Sum of maximal deviations of delay in material delivery and dead time of equipment. In this case the guarantee estimation of volume of insurance inventory with a zero risk is obtained. It makes (table.1) 2,8 days.

2. Traditional (good practice) estimation - 50% from a current supply - 0,7 days.

3. Estimation, from simulation on the basis of distribution function of constituents of insurance inventory.

The actual arguments of deliveries considerably differ from planned (fig.3), because of influence of factors of risks (table 1).

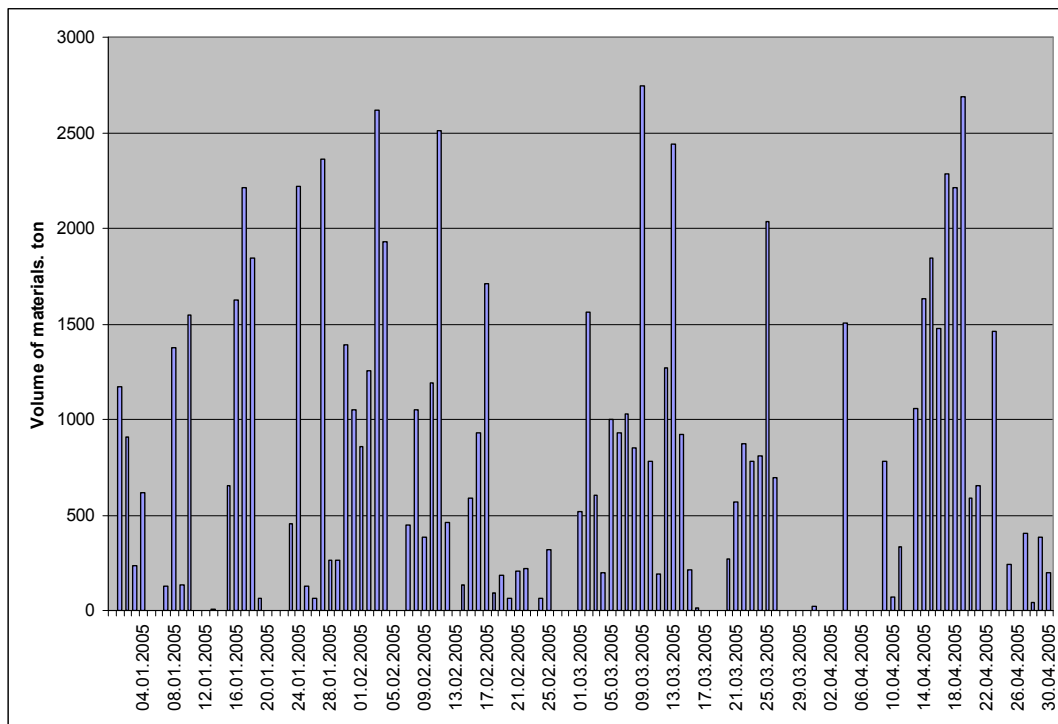


Fig. 3. Statistics of materials supplying for 4 months

For the simulation of probability distribution of time of delay of materials supply and dead time of equipment will take advantage of next statistical information.

Table 2. Data of insurance inventory given for a simulation

№	Risks	Interval of deviations, day		Parameters of deviations distribution	
		Minimum	Maximum	Mean deviations, day	Probability of deviations
1	Insufficient quality and incomplete deliveries of materials	-0,1	0,24	0,05	20%
2	Delays of shipping	-0,5	0,44	1	10%
3	Delays of transporting	-0,5	0,8	1,5	20%
4	Delays at unloading and warehousing	-0,08	0,12	0,08	30%
5	Delays at preparation of materials	-0,08	0,07	0,03	30%
6	Increase of amount and volumes of orders	-0,15	0,88	0,26	70%
7	Unevenness of production	0	0,23	0,15	50%

Probability distributions of risks are approximated by gamma density. Distributions are showed on fig.4 and 5 as example for some risks.

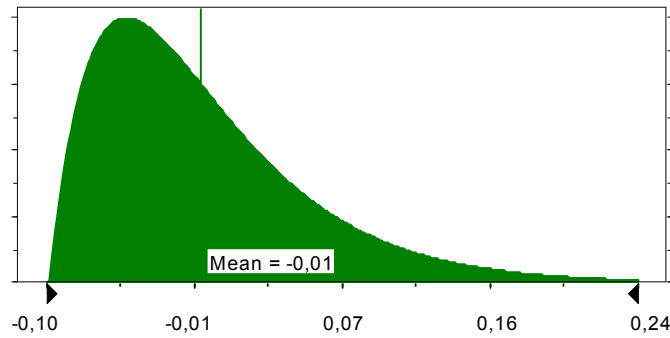


Fig.4. The distribution of dead time of equipment for risk №1 (Insufficient quality and incomplete deliveries of materials)

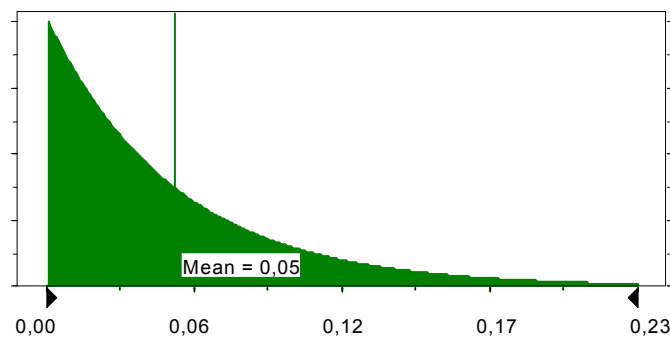


Fig. 5. The distribution of dead time of equipment for risk №7 (Unevenness of production)

As a result of simulation the bell-shaped distribution of delay of supplying with materials and dead time of equipment is got (fig.6).

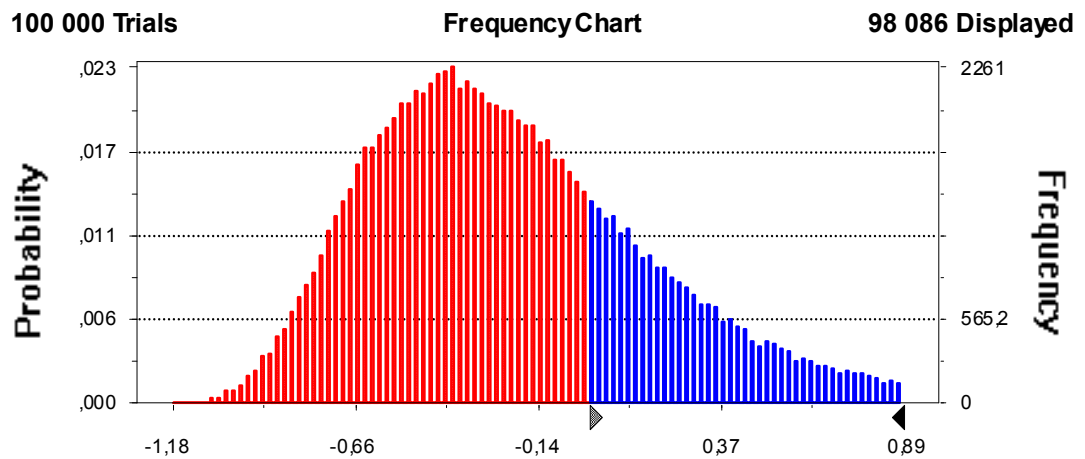


Fig.6. The distribution of delay of supplying with materials and outage of equipment

Parameters of distribution are presented on fig.6:

- interval of duration of delays and outage, day 0-2,8
- probability of delays and outage, % 27
- expectation value of delays and outage, day 0,26
- confidence interval of duration of delays and outage (probability 0,99), day 0-0,9

As follows from fig.6, the rational volume of insurance inventory of materials, got on results a simulation, makes 0,9 day.

Thus, it is possible to compare the variants of estimations of insurance inventory.

Table 3. Estimations of volume of insurance inventory

Estimation of insurance inventory	Guarantee estimation	Good practice	Simulation
Volume of insurance inventory, day	2,8	0,7	0,9
Coverage of risk an insurance inventory, %	100	85	99
Residual risk (probability), %	0	15	1
Interval of delays and outage, day	0	0,7-2,8	0,9-2,8
Expectation value of delays and outage, day	0	0,8	0,9

Conclusions from the resulted research regard to the volumes of insurance inventory of materials followings:

1. The guarantee estimation sets too high the volumes of inventory considerably, because does not take into account distribution of probabilities of duration of delays of supplying with materials and outage of equipment.
2. Good practice gives an average on industry estimation and it is oriented on the stable terms of supplying with materials and long-term relations within the framework of the planned economy. Such estimation, probably, is a low bound for the modern market conditions of production.

- Simulation for the concrete company in modern terms of production, related to mobility and changeability of external and internal factors, gives more grounded estimation of volumes of insurance inventory. This estimation lies in an interval, limited from above guarantee and from below good practice estimations.

If a company assumes the delay of supplying with materials, i.e. sets some level of risk-appetite for supplying with materials, the volume of insurance inventory does not change in this case, but frequency of his filling in goes down.

For example, if a risk-appetite is equal 0,15 days, probability of delay of delivery in an interval 0,15-2,7 days will go down to 20%, and frequency of replenishment will be reduced in 1,3 time.

The use of process of forming and replenishment of insurance inventory allows more grounded to solve the problem of estimation actually parameters of supplying with materials, namely the problem of the choice of rational volumes and periodicity of delivery.

Below on fig.7 total costs of supplying with raw materials are shown, including ordering, transportation, storing and interest rate costs.

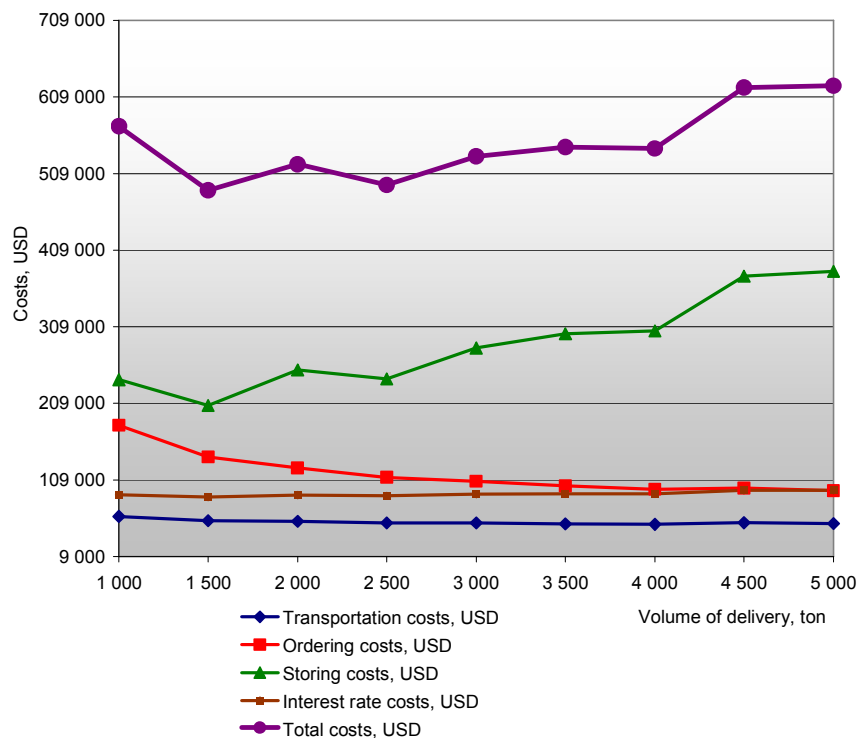


Fig.7. Estimation of rational parameters of materials supplying

As follows from the figure resulted higher, the volume of delivery makes 2000-2500 ton. Periodicity of 3 days corresponds to this volume. The insurance inventory of materials

makes 580 ton, that corresponds 0,9 days are appraised at the simulation of duration of supplying with material (fig.3).

The change of inventory during a month is resulted on fig.8.

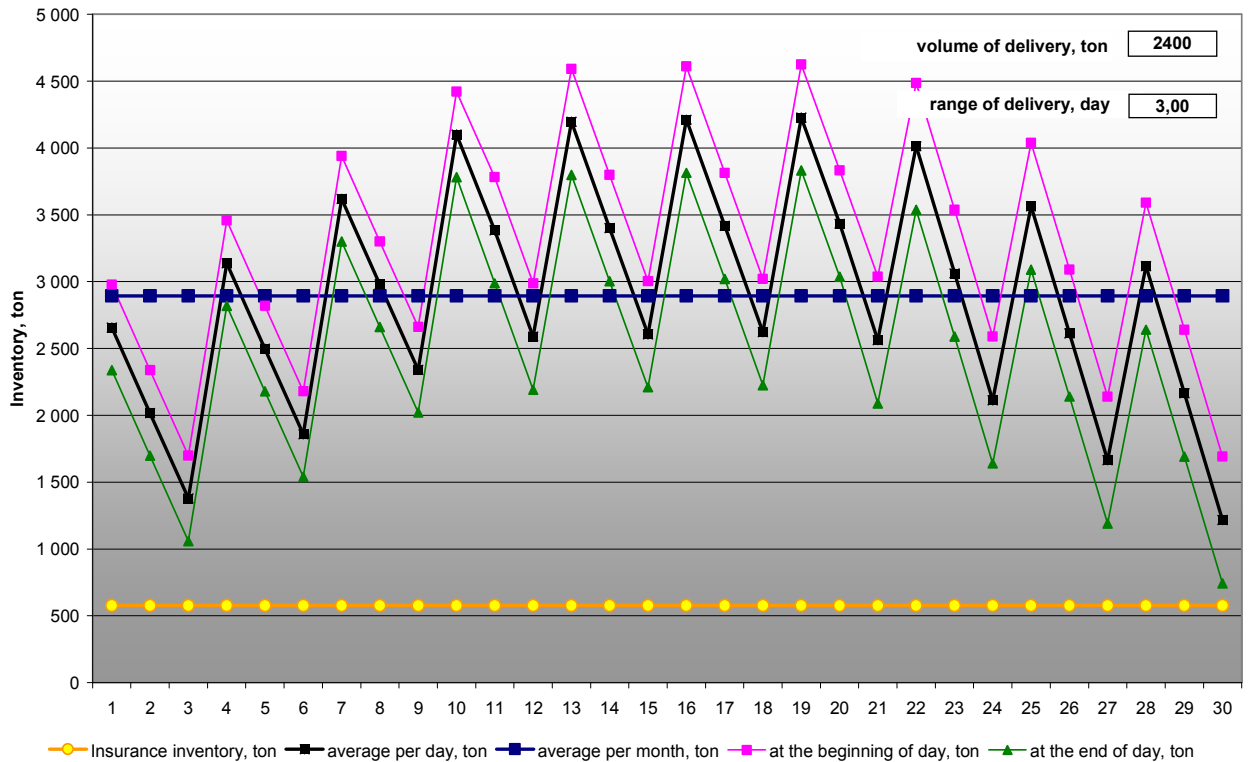


Fig.8. Change of inventory during a month

At the calculation of volumes of inventory a risk factor №7 was taken into account - it is an unevenness of production - with the followings parameters:

- 1 ten-day period – 27%;
- 2 ten-day period – 33%;
- 3 ten-day period – 40%.

If a production was balanced load, the volume of insurance inventory would make 480 ton, or 0,75 days (fig. 9). This difference of 100 ton, or 0,15 days and there is a contribution of unevenness of production to the volume of insurance inventory, appraised at ranging of risks (table 1).

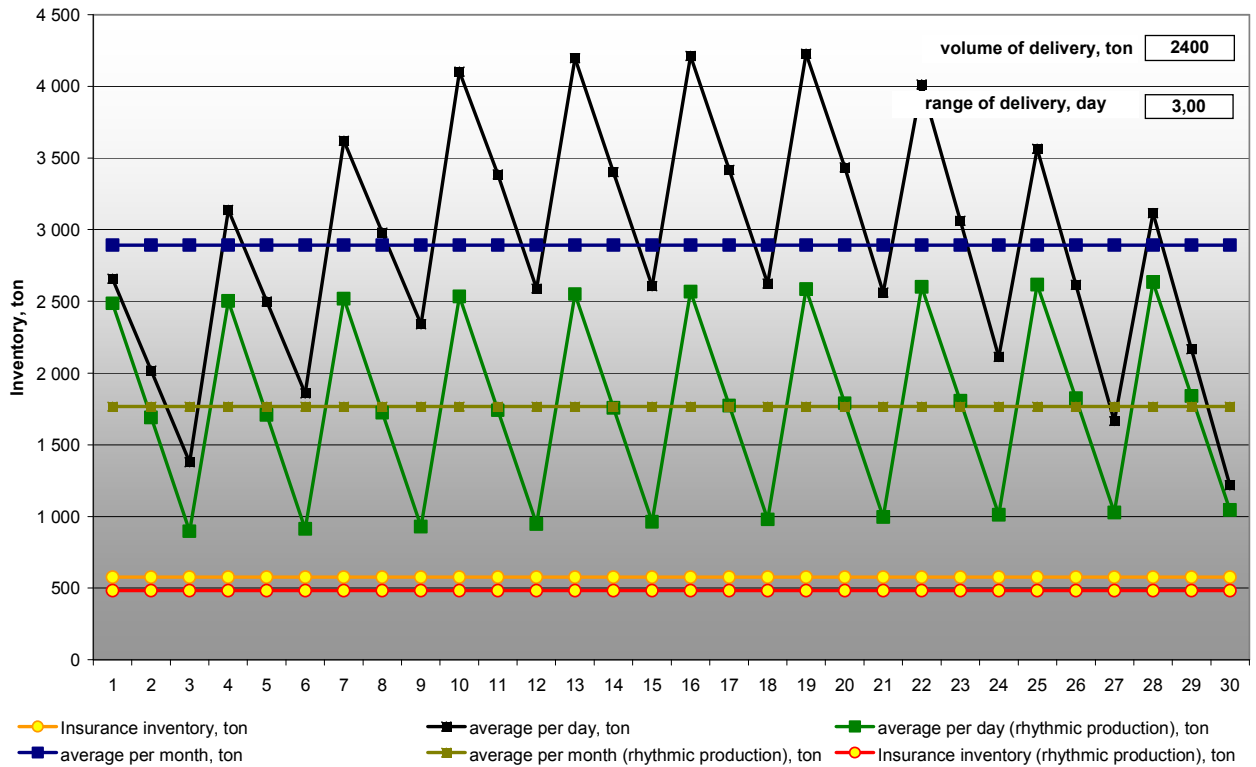


Fig.9. Change of inventory during a month at a rhythmic and unrhythmic production

Thus, realization of effective measure of mitigation of risks, such as forming and maintenance of insurance inventory, allowed to reduce the risks of business process of supplying with materials to the acceptable level, that is showed on fig.10.

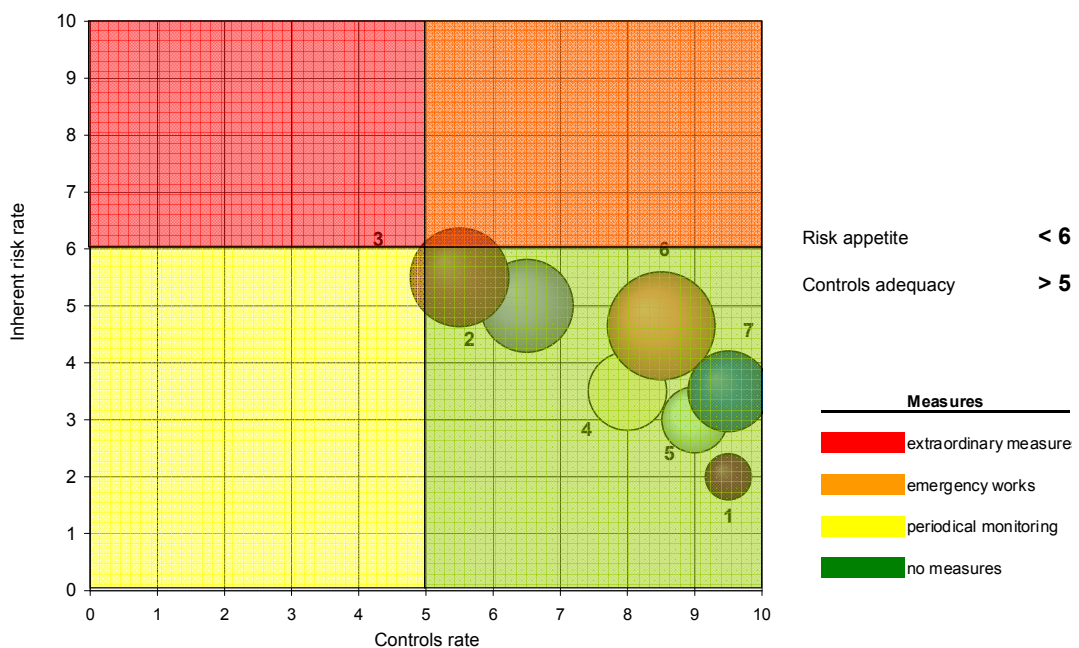


Fig.10. The map of risks taking into account an insurance inventory

As an additional measure of the response on risks it is necessary to consider the variants of new suppliers of materials and carrier companies which would execute the requirements of contracts more neatly.

The presented methodology of risk management of business process of supplying with materials in general is universal and can be applied for risk management of other business processes in the chain of development, production and sale of commodities to clients.

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