Gentiana Sharku[1]

INVESTMENT DECISION MAKING IN RISK CONTROL ACTIVITIES

Abstract: Risk management involves implementation of several techniques which are classified in two categories: risk control and risk financing techniques. All the techniques used in risk management are not costless. The risk manager has to compare the amount of benefit from reducing the risk and the amount of money needed to carry out the technique. Financial analysis can be employed to assist in the risk control decision making. This lesson will briefly describe the set of techniques that are involved in risk control activities such as avoidance, loss prevention and reduction, diversification, duplication and separation. There are several tools at disposal of the risk manager to assess the economic benefit of the risk control technique implementation. This lesson will discuss two of them: Cost-benefit analysis and Capital budgeting process, illustrating by respective examples.

[1] Prof.Asoc.Dr. Faculty of Economy, University of Tirana, gentianasharku@feut.edu.al

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INTRODUCTION

Risk control refers to the measures taken by an organization/individual that avoid a risk or reduce the severity or the frequency of losses. For example, maintaining plant safety-inspection programs, building with fire-resistant materials or installation of an automatic sprinkler system that extinguishes a fire will reduce the excepted loss; or safety features on products will not permit the consumers to use hazardous products; or putting the snow tires by the vehicle drivers in ice streets will avoid or prevent the accidents occurring, etc. The selection of best methods to handle the risk takes place after the exposure to risk have been recognized and the size of loss has been estimated. Risk management literature suggests that risk control techniques be used especially when the loss frequency is high and loss severity is either low or high, in order to reduce the undesirable effects of the loss. More formally, risk control includes techniques, tools, strategies, and processes that seek to avoid, prevent, reduce, or otherwise control the frequency and/or magnitude of loss and other undesirable effects of risk; risk control also includes methods that seek to improve understanding or awareness within an organization of activities affecting exposure to risk (William at al. 1998).

1. RISK CONTROL TECHNIQUES

The risk control techniques include a) avoidance which means that the risk is abandoned; b) prevention which refers to the measures that reduce the loss frequency; c) reduction which refers to the measures that reduce the loss severity; d) diversification which reduce the risk by spreading the loss exposures among different parties, e) duplication and f) separation.

Large business organizations often employ loss control engineers and experts to identify sources of loss or injury and to plan and implement corrective measures. For example, injuries during work can derived from the poor conditions of workplace, lack of safety measures or improperly training of the workforce. Good loss control programs can be designed and implemented by the risk manager to obtain the required objectives.

1.1. Avoidance

Avoidance refers to the decision of a firm not to exposure to a particular risk of loss. For example, product liability suits can be avoided when a pharmaceutical company decides to interrupt the production of certain drugs with dangerous side effects; or the flood losses can be avoided by building a new plant on a well above a floodplain. Through avoidance, the chance of loss is reduced to zero or eliminated as the activity or the property giving rise to the possible loss is abandoned. Some authors distinguish between proactive avoidance (when the risk is immediately abandoned or refused) and abandonment (when the risk assumed earlier is later abandoned).

Generally, avoidance is recommended to be employed when the loss exposure to the risk is both severe and frequent, i.e. a loss is expected to occur often and when it occurs it causes large damages. But often avoidance can be impractical to be used. By avoiding a risk, the organization will be sure of not experiencing the potential losses, but it will lose the potential profit that may be derived from the risk undertaking. The businesses know that if there is no risk, there is no profit. In order to gain, they must undertake some

risks. The cost of loss avoidance is the sacrifice of the benefits from the activity that gave rise to the potential loss (Harrington 2004).

On the other hand, sometimes avoidance is impossible to be used. Some losses cannot be avoided. For example, a business organization cannot be able to avoid the premature death of a key executive. Avoidance is also called as an extreme example of loss prevention technique.

1.2. Prevention

The risk manager is highly involved in loss prevention activities. Ideally, risk manager would like to eliminate the risk. But as above mentioned, it is not always practical and possible. *Loss prevention refers to the measures taken to reduce the frequency of a loss*. Numerous activities reduce expected losses by reducing the frequency of losses. For example, measures that reduce the number of auto accidents include zero tolerance for alcohol and drug abuse, enforcement of safety rules, construction of appropriate barriers, lighting and road signs in highways etc.; measures that reduce the probability of being suit under product liability law, include careful product design, quality-control tests, placement of using instructions and proper maintenance conditions etc.

1.3. Loss reduction

Loss reduction refers to the measures that reduce the potential severity of a loss. Despite the loss prevention measures, some losses occur. Loss reduction technique aims to minimize the magnitude of loss. For example, installation of an automatic fire-sprinkler system would not reduce the probability of loss (it does not prevent a fire from occurring), but it reduces the amount of damage if fire occurs (reduce loss severity).

Loss reduction activities may occur before and after a loss. Pre-loss activities refer to measures taken before a loss occurs, for example installation of first aid-boxes or air bag systems in the cars. Post-loss reduction activities refer to the measures taken immediately after the loss occur, in order to reduce the amount of loss, for example rehabilitation of workers with job-related injuries. Disaster planning constitutes a pre-loss reduction activity. The plans for evacuation, medical treatment, power restauration and clean up aim to reduce the severity of the losses from catastrophes.

1.4. Diversification

Diversification refers to the measures taken to reduce the chance of loss by spreading the loss exposure across different parties (e.g., customers and suppliers), securities (e.g., stock and bonds), or transactions (Rejda, 2017). Therefore, diversification is used to minimize several types of risk, such as financial risk, production risk, liability risk, etc. For example, an investor may reduce the investment risk by investing in several securities of several businesses; a production company may reduce the output risk and input risk by contracting different customers and suppliers; or a business instead of selling in one limited market, may reduce the risk by entering in different geographic markets.

1.5. Duplication

Duplication refers to the measures taken to keep backups or copies of an existing asset in reserve, to be used in case that the original asset is managed or destroyed. Duplication often is employed in cases in which the loss of use arises from the direct damage to the asset. In such cases, the duplication reduces the amount of damage if a loss occurs by reducing or eliminating the indirect loss. Duplication often serves in the dual roles of loss prevention and loss reduction. Duplication reduces the probability of an indirect loss because the duplicate may be available for use if the original asset cannot be used (William at al. 1998). Examples include storing information and business records (employee records, receivable accounts, sales transactions and other financial information) on a backup server to use in case the original server fails.

1.6. Separation

Separation refers to the measures taken to isolate the loss exposures from each other or to divide the assets exposed to loss in order to minimize the damaged caused from the loss. For example, a company may divide the storing inventory in two separate warehouses in order to minimize the losses if one of the building is destroyed; or dividing the interior production area into several compartments separated by fire-resistant materials will prevent the fire from spreading. This type of loss control method is called separation or segregation of exposure units.

Some authors consider separation as a form of diversification. Indeed, there is a difference between diversification and separation as methods of risk control. Diversification limits the exposure to the risk of a single asset. It reduces the probability of suffering very high losses. According to the diversification principle, by diversifying across several risky assets or markets, the probability of very high losses is reduced, but the excepted loss is not changed. While, as separation increases the frequency of losses and reduces the expected severity of losses, it may be considered as a loss reduction activity.

The following example explains how the separation reduces the severity of losses. Suppose an agriculture firm that cultivate strawberries would like to expand its activity. The risk manager has two alternatives: (i) to double the size of the existing greenhouse, which value amount to 100.000€; and (ii) to build a new greenhouse in another location, which has the same value as the first one. By building another greenhouse in another location, the risk manager tends to control the losses from the floods. Assume that the floods in each location are independent events and the probability of flood in each location is 1%.

If the firm doubles the existing greenhouse, it has 1% chance of suffering a loss of 200.000€ and 99% chance of suffering no loss. Therefore, the loss frequency is 1%, the loss severity is 200.000€ and the excepted loss will be 2.000€ (200.000€ x 0,01).

If the firm build a new strawberry greenhouse in another location, it has 0,0001 (0,01 x 0,01) chance of suffering a loss of 200.000€, it has a chance of 0,0198 (0,01 x 0,99 x 2) chance of suffering a loss of 100.000€, and it has a chance of 0,9801 (0,99 x 0,99) chance of suffering no loss. Therefore, the expected loss frequency is 0,0199 (0,0001 + 0,0198), the expected loss severity is 100.502,5€ (200.000 x 0,0001/0,0199 + 100.000€ x 0,0198/0,0199), and the expected direct loss will be 2.000€ (100.502,5€ x 0,0199).

Hence through separation, the risk manager may reduce the loss severity, increasing the loss frequency, but the expected loss does not change.

2. INVESTMENT DECISIONS

Business organizations reduce the probability of being suit under product liability law by designing, manufacturing and marketing safe products. Selling safe products means that the business should spend money and time to test the products for a longer time period, to place the warning labels in the dangerous products, and to use the quality-control check. On the other hand, reducing the number of lawsuits, the businesses will experience a cut in the legal fees and in the compensation paid to the injured parties, as well as the company's reputation will be less affected. Therefore, the risk control activities are not costless. In deciding upon the proper loss control activities, the risk manager must compare the costs of loss control measures and the benefits expected to be derived. Only when the benefits exceed the costs, the activity must be undertaken. Financial analysis can be employed to assist in the risk control decision making. There are several tools at disposal of the risk manager, but this section illustrates two of them: Cost-benefit analysis and Capital Budgeting.

2.1. Application of cost-benefit analysis

Loss control measures are effective only if the benefits realized from fewer occurrences of loss are greater than the cost of the loss control measures. Suppose that one company must decide how much to spend on the safety equipment for its plant. Risk manager has evaluated that if the company spends 25.000 € on safety equipment, the expected number of the injured workers will be 20; if it spends 25.000 € more the number of the injuries will be decreased to 16; if the firm spend 25.000 € more, the number will decrease to 13, and so on as the columns 1 and 2 of the Table 1 shows. The expected average loss to the injured workers is calculated to be 10.000 €. If the firm spends 25.000 € on safety equipment, it will have to pay 200.000€ as compensation to the injured workers (the expected accident cost). But if the firm spends 25.000€ more, the indemnification amount would be 160.000€, i.e. it will be reduced by 40.000 €. *As long as the benefit exceed the cost (investment), the firm is willing to undertake the investment*. If the firm spends an additional amount of 25.000€, the indemnification amount will be reduced by 30.000€. Again, the benefits are greater than the cost and the firm will make the investment of 25.000€. The Table n. 1 shows the additional benefit (marginal benefit) and additional cost (marginal cost) for each level of investment.

Table 1

Investment Cost (1)	No. of injured workers (2)	Indemnification payment (3)	Marginal Cost (4)	Marginal benefit (5)
25.000€	20	200.000€	-	-
50.000€	16	160.000€	25.000€	40.000€
75.000€	13	130.000€	25.000€	30.000€

| 100.000€ | 11 | 110.000€ | 25.000€ | 20.000€ |
| 125.000€ | 10 | 100.000€ | 25.000€ | 10.000€ |

The company will stop to invest when the marginal cost exceeds the marginal benefit. As the table shows, the firm will invest only 75.000€, because if the firm invest more than 75.000€, the marginal cost of 25.000€ exceeds the marginal benefit of 20.000€. Hence, the optimal investment level is 75.000€.

2.2. Application of Capital Budgeting

Risk control investments can be analyzed through the capital budgeting method, by employing time value of money technique. This technique is useful when the cash inflows and/or outflows have been distributed over a period of time.

Time Value of Money. It is generally agreed that (i) more money is better than less money, and (ii) money today is worth more than the same amount of money received in the future. Therefore the value of money is not the same over the time. Time value of money takes into consideration the compound interest. Compounding is the process by which interest is calculated on both the principal amount and the interest that was previously earned. Suppose you deposit 1000€ in a bank account, which pay you an 4% interest rate on this saving account. At the end of the first year the balance of the saving account will be 1.040€, consisted of the principal amount (1.000€) plus the earned annual interest (40€). If the interest is accumulated in the account, at the end of the second year, the balance of the account will 1.081,6€, consisted of the amount at the beginning of the second year (1.040€) and the interest earned of this amount (1.040€ x 4% = 41,6€). In general, the future value of a lump sum is calculated by the following formula:

$$FV_n = PV \times (1+i)^n \qquad \textbf{(1)}$$

For example, the balance of the saving account at the end of the tenth year will be:

$$FV_{10} = 1.000 \times (1+4\%)^{10} = 1,482,2 \text{ €}$$

If you deposit annually 100€ (denoted „A") in a saving account that pays 4% interest, the balance at the end of the tenth year is calculated by the following formula:

$$FVA_n = A \times \sum_{t=0}^{n-1}(1+i)^t \qquad or$$

$$FVA_n = A \times \frac{(1+i)^n - 1}{i} \qquad \textbf{(2)}$$

In this case, the balance at the end of the tenth tear will be:

$$FVA_{10} = 100 \times \frac{(1+0,04)^{10} - 1}{0,04} = 1.200,61 \text{ €}$$

The formulas (1) and (2) are used both to calculate the future value of money. The utilization of the equations depends of the type of cash flow. The first equation is used to calculate the future value of a lump sum, i.e. of one Euro. The second equation is used to calculate the future value of a series of equal periodic amounts that last for a certain period of time, called annuity.

The reverse process of compounding is called discounting. Discounting is the process of determining the present value i.e. an arithmetic process whereby a future value decreases at a compound interest rate over time to reach present value.

The formula for the calculation of the present value of a lump sum is derived by the Formula 1, as follows:

$$PV = FV_n \times \left[\frac{1}{(1+i)^n} \right] \qquad \textbf{(3)}$$

Implementing the Formula 3, the present value of €1.000 to be received ten years from today, is calculated as follows:

$$PV = 1.000 \times \left[\frac{1}{(1+0,04)^{10}} \right] = 676€$$

In this case, you will be indifferent in choosing between 676€ today and 1.000€ received after ten years, because the future value at the end of the tenth year of 676€ willbe 1.000€, and vice versa.

If you have to find the present value of a series of payments (annuity), the following formula is utilized:

$$PVA = A \times \sum_{t=1}^{n} \frac{1}{(1+i)^t} \qquad or$$

$$PVA = A \times \frac{1-(1+i)^{-n}}{i} \qquad \textbf{(4)}$$

The present value of an annuity of 100€ that is to be received for ten years, when interest rates are 4%, is determined by replacing the values at the Formula 4:

$$PVA = 100 \times \frac{1-(1+0,04)^{-10}}{10} = 811€$$

In this case you will be indifferent in receiving an amount of 811€ today and receiving €100 per year for the next ten years.

Fortunately, there are easier ways to determine the future value or the present value. The calculations may be done by using (i) an interest factor table, (ii) the financial electronic calculators, or (3) a computer program such as Excel.

After this short presentation of the technique of time value of money, the following pat of the section explains the capital budgeting methods used in investment decisions.

Capital budgeting is the process that analyzes the investment alternatives and selects the most appropriate investment(s) that should be undertaken.

There are several discounting methods employed in capital budgeting: but for risk control decisions, this section considers two of them: the net present value (NPV) and the internal rate of return (IRR). Both methods (i) consider the time value of money technique; (ii) recognize that investment decisions are made at the present and the cash inflows are generated in the future; (iii) compare the investment's cash outflows with future cash inflows, bringing them in present values. In context of loss-control activities, the investment cost constitutes the cash outflow, while the reduction of future payments (damage compensations or indemnifications) constitutes the cash inflows.

Net Present value (NPV). The net present value is the sum of the present values of future cash inflows minus the present value of the investment's cost (cash outflows). The present value of the cash flows is usually calculated by discounting them at the firm's weighted average cost of capital (WACC), which is the weghted average of the costs of a firm's sources of financing (or any other rate that financial manager considers appropriate for the investments). If NPV is positive or zero, the investment is accepted. If NPV is negative, the investment is rejected.

Internal Rate of Return (IRR). The internal rate of return method determines the rate of return which equates the present value of the cash inflows and the present value of the cash outflows of the investment. This rate of return is called the internal rate of return because it is a rate that is unique (internal) to that investment. In effect, the internal rate of return method satisfies the following equation:

Present Investment Cost = Present value of the Cash Inflows

The investment is accepted if the internal rate of return exceeds or is equal to the firm's cost of capital. If the internal rate of return is smaller than the capital cost, the investment is rejected.

Suppose that the risk manager of pharmaceutical company would like to reduce the number of liability lawsuits from the clients. He discovered that the one of the reasons is the untrained workforce. In collaboration with human resources office, they developed a training program with a training agency. Training program costs 20.000€, and the risk manager has calculated that the expected indemnification for the next five years would be reduced by 5.000€. If the firm's weighted average capital cost is 6%, should the risk manager accept the investment proposal?

The cash out flow of this investment is the investment's cost of 20.000€, and the cash inflow is the series of periodic amounts of 5.000€, which is the amount by which the indemnification payments will be reduces in the next five years. If the cost of capital is 6 percent, the present value of the investment is the sum of the present value of each cash flow discounted at 6 percent. The calculations are shown in the Table 2.

Table 2

Year	Cash inflow	Interest factor	Present value
1	5.000€	0,9434	4.717€
2	5.000€	0,8900	4.450€
3	5.000€	0,8396	4.198€
4	5.000€	0,7921	3.960,5€
5	5.000€	0,7473	3.736,5€

The individual present values are summed in order to provide the present value of the investment. The present value of the cash inflows for the next five years discounting at 6% is 21.062€. Since the cost of investment is 20.000€, the net present value of the investment is:

$$NPV = 21.062 - 20.000 = 1.062€$$

Thus, investment NPV is 1.062€. As the NPV is positive, the risk manager will accept the proposal. It means that the reduction in the future payments (benefits) exceeds the cost (outlay) of the investment, measured both in actual terms.

Regarding the IRR method, risk manager finds the rate of return which equals the present value of 5.000€ per year for five years to 20.000€ (investment cost). Therefore, the internal rate of returns is the rate that satisfies the following equation:

$$20.000 = \frac{5.000}{(1+r)^1} + \frac{5.000}{(1+r)^2} + \frac{5.000}{(1+r)^3} + \frac{5.000}{(1+r)^4} + \frac{5.000}{(1+r)^5}$$

The above equation is solved for the unknown term „r", which is the internal rate of return. Using interest factor tables of financial calculators, the problem is easily solved. The rate which satisfy the above equation in 7,3 percent. This means that the internal rate of the return of the investment is 7,3 percent. As the internal rate of return (7,3%) is greater than the firm's cost of capital (6%), the investment proposal is accepted according to the IRR method.

The net present value and the internal rate of return methods are very similar. They consider the time value of money technique, and include in calculations the whole cash flow generated from investment. In the above example, the investment is accepted by both methods. However, these two methods do not always agree on whether an investment should be accepted or not. This is the subject of a more advanced discussion, which is not covered here.

3. CONCLUSIONS

Every business faces risk and the general attitude of individuals and business firms is risk-aversion. Risk manager has several techniques at disposal to reduce the risk faced by organization. He can choose to control the risk or to finance it. In both cases, the risk management process is not costless. In deciding upon the proper loss control activities, the risk manager must compare the costs of loss control measures and the

benefits expected to be derived. Only when the benefits exceed the costs, the control activity must be undertaken. For this purpose, risk manager can employ the cost benefit analysis and the methods of capital budgeting process. Both methods compare the amount of benefit from reducing the risk and the amount of money needed to carry out the technique. The methods of capital budgeting can be used when the costs and benefits are spread over a period of time in the future, and hence, they use the technique of time value of money.

4. REFERENCES

[1] Besley and Brighman, 2006. Principles of Finance, Thomson South-Western.

[2] Dorfman, S. Mark. 2005. *Introduction to risk management and insurance*. New jersey 07458, Pearson Prentice Hall.

[3] Herbert B. Mayo, 2007. *Basic Finance: An introduction to Financial Institutions*, Thomson South-Western.

[4] Mehr R., Cammack E. 1980. *Principles of insurance*. Richard D. Irwin Inc.

[5] Rejda, E. George 2000. *Principles of risk management and insurance*. Pearson Education.

[6] Rejda, E. George 2003. Principles of risk management and insurance. Pearson Education.

[7] Zvi Bodie, Robert C. Merto, 2000. *Financial Economics.* Pearson Education.

TEST QUESTIONS

1. What risk management technique is illustrated by each of the following statements:

   - After the tests revealed an experimental drug produced harmful side effects, Pharma Company discontinued the drug production.

   - Due to the ice and snow, the drivers put snow tires on their vehicles during winter months.

   - ABC company installed a sprinkler system in the dry cleaning area.

   - The installation of the airbag system in cars.

   - Placing plywood over windows that are broken in a storm.

   - Building two warehouses in different locations.

2. ABC Corporation is trying to determine how much to spend on safety equipment for its plant. The probability of explosion at the plant depends on how much the firm spends on safety as given by the following table. If an explosion occurs, the

economic loss (damage of equipment, injuries of employers) is expected to be €60.000.000. Find the optimal level of safety expenditure.

Safety expenditure (thousand€)	Probability
0€	0,030
500.000€	0,020
700.000€	0,016
1.000.000€	0,013
1.300.000€	0,011
1.700.000€	0,010

3. Zeta Transport Company is trying to decide whether to require its drivers to take a driver safety course. The company has 50 drivers and the cost of the course per driver is €3.000. If all the drivers follow the course, the insurance company will reduce the firm's auto insurance premium by €60.000 immediately and by €60.000 in each of the next three years. Should the company require its drivers to take the course, if the firm's cost of capital is 5%?

ANSWERS TO TEST QUESTIONS

1. What risk management technique is illustrated by each of the following statements:

- After the tests revealed an experimental drug produced harmful side effects, Pharma Company discontinued the drug production - Avoidance.

- Due to the ice and snow, the drivers put snow tires on their vehicles during winter months. – Loss prevention

- ABC company installed a sprinkler system in the dry cleaning area. – Loss reduction

- The installation of the airbag system in cars. – Loss reduction

- Placing plywood over windows that are broken in a storm – Loss reduction

- Building two warehouses in different locations - Separation

2. Calculation of marginal benefits and the marginal costs are as follows:

Safety exp. (1)	Probability (2)	Indemnification payment (3)	Marginal Cost (4)	Marginal benefit (5)
0	0,03	1.800.000€	-	-
500.000€	0,02	1.200.000€	500.000€	600.000€
700.000€	0,016	960.000€	200.000€	360.000€
1.000.000€	0,013	780.000€	300.000€	180.000€

| 1.300.000€ | 0,011 | 660.000€ | 300.000€ | 120.000€ |
| 1.700.000€ | 0,010 | 600.000€ | 400.000€ | 60.000€ |

ABC Corporation is going to spend on safety equipment, as long as the marginal benefits (indemnification reduction) will exceed the marginal costs, i.e. at the level of 700.000€.

3. This exercise can be solved through two methods:

According to NPV: The cost of investment is course's cost: 3.000€ x 50 = 150.000€. The investment's benefits are the premium reductions of 60.000€ per year.

As the cost of the capital is 5%, the net present value of investment is calculated as follows:

$$NPV = -150.000 + 60.000 + \frac{60.000}{(1+0,05)^1} + \frac{60.000}{(1+0,05)^2} = 21.565 \text{ Euro}$$

As the net present value of investment is positive, the company should undertake the investment.

According to IRR: In order to find the IRR, the following equation should be solved:

$$150.000 = 60.000 + \frac{60.000}{(1+r)^1} + \frac{60.000}{(1+r)^2}$$

The interest rate that satisfy the equation is 21,53%.

As the internal rate of return investment (IRR = 21,53%) is greater than the firm's cost of capital (5%), the investment should be undertaken.