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Risk Management in the Business of the Manufacturer

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Article History	*Abstract*
Received: 06 June 2023 Revised: 09 September 2023 Accepted: 24 September 2023	*This research paper will start by presenting background information to risk management in the manufacturing sector followed by review of the literature for state of the art knowledge in this subject area. An algorithm for generic risk management system will be presented highlighting the various stages from establishing the risk context, assessment, evaluation and managing it. Finally, a risk management framework will be developed showing the sequence for assessing potential risk factors associated with the typical manufacturing process This research paper will start by presenting background information to risk management in the manufacturing sector followed by review of the literature for state of the art knowledge in this subject area. An algorithm for generic risk management system will be presented highlighting the various stages from establishing the risk context, assessment, evaluation and managing it. Finally, a risk management framework will be developed showing the sequence for assessing potential risk factors associated with the typical manufacturing process This research paper will start by presenting background information to risk management in the manufacturing sector followed by review of the literature for state of the art knowledge in this subject area. An algorithm for generic risk management system will be presented highlighting the various stages from establishing the risk context, assessment, evaluation and managing it. Finally, a risk management framework will be developed showing the sequence for assessing potential risk factors associated with the typical manufacturing process This research paper will start by presenting background information to risk management in the manufacturing sector followed by review of the literature for state-of-the-art knowledge in this subject area. An algorithm for generic risk management system will be presented highlighting the various stages from establishing the risk context, assessment, evaluation and managing it. Finally, a risk management framework will be developed showing the sequence for assessing potential risk factors associated with the typical manufacturing process This research paper will start by presenting background information to risk management in the manufacturing sector followed by review of the literature for state of the art knowledge in this subject area. An algorithm for generic risk management system will be presented highlighting the various stages from establishing the risk context, assessment, evaluation and managing it. Finally, a risk management framework will be developed showing the sequence for assessing potential risk factors associated with the typical manufacturing process Project activities are carried out in conditions of uncertainty. Therefore, knowledge of the basics of project risk management necessary in the professional activities of economists, managers and entrepreneurs. At the stage of creating a business in the*

	process of developing a business plan, an entrepreneur needs to evaluate economic efficiency and risks of this business project, develop a risk management plan, plan a response to possible risks. When the established enterprise is located at the stage of its further development, then in the process of implementation various projects - to expand business, organizational projects – risk management is also required. In addition, at the stage of decline, when the organization is in crisis, it is necessary to develop projects for the improvement of this enterprise, in the process implementation of which risk management is required. All this emphasizes the relevance of the issues considered in this study guide.
	Keywords: *Regularly, project, creat, activities, limit, number, risk.*

1. Introduction

Each of us regularly faces projects in everyday life, in particular, in the course of work, during repairs, travel, job search. But at the same time, little who thinks that he is dealing with a field of knowledge.

"Project management".Project (from lat. projectus) means "thrown forward". There are a significant number of project definitions. For example, it can be defined as follows: "A project is a time-limited activity to create new (unique) products, services, or results."Project activities differ significantly from operational activities:

1) the duration of the project is limited in time;
2) a project team is created for one project and disbanded after its completion;
3) obtaining a unique product (service, result) is associated with the uncertainty of many project parameters and leads to to a large number of risks (including critical ones);
4) uncertainty and significant risks lead to the need to make significant changes to the project.

Analyzing the third and fourth points, it is easy to see that a vicious circle is obtained: the more changes, the more risks, and the more risks, the more changes. Therefore, risks need to be managed. Risks affect the main constraints of the project (“triple restriction", "iron triangle").

Main part

Risk and Opportunity Response Planning is the process of developing ways and defining actions to increase opportunities and reduce threats for the project objectives. This process begins after the quality and quantitative risk analysis. It includes the identification and appointment of one or more responsible persons ("responsible responsible for responding to risks”), whose duties are includes a response to each agreed and supported budget risk. Risk response planning considers risks according to their priorities; as needed, new resources and activities are added to the cost, schedule, and project management plans. Planned risk response operations should be appropriate to the severity of the risk, be cost effective in addressing the problem, timely, realistic in the context of the project and agreed with all participants, and the implementation of activities should be entrusted to the responsible face. Often requires choosing the best way to respond on risks from several possible options. Possible strategies for responding to risks and threats evasion. Risk avoidance involves changing the project management plan in such a way as to eliminate the threat, caused by a negative risk, insulate the project objectives from the consequences of the risk, or weaken the threatened objectives (for example, expand the scope of the schedule or reduce the scope of the project). Some of the risks that arise in the early stages of a project can be avoided by clarifying requirements, obtaining information, improved communication;

- transmission. Risk transfer involves shifting the negative consequences of a threat with responsibility for responding at risk to a third party. The transfer of risk simply transfers the responsibility for its management to another party, while the risk is not eliminated. Delegation of responsibility for risk is most effective in relation to financial risks. The transfer of risk almost always involves the payment of a risk premium to the party taking the risk. Risk transfer tools numerous and varied; these include, in particular, the use of insurance, performance bonds, warranties, etc. Conditions for the transfer of liability for certain risks to a third party may be determined in the contract. In many cases, in a cost-

benefit contract, risk costs may be passed on to the buyer, and in a fixed price contract the risk can be shifted per seller if the development of the project is already in a stable state. A producer of agricultural products constantly faces risks. And this is not only due to the fact that he runs an open-air business, and his crops are affected by adverse weather, agricultural pests and diseases. Its income also depends on the cyclicality and current situation in the world commodity markets (and, as a result, the level of prices for agricultural products), on the coordinated and reliable operation of the market infrastructure, on the decisions of the authorities, and on many other factors. At the same time, a crop failure or a serious decline in the quality of agricultural products affects the entire supply chain of agricultural products. Banks, as well as suppliers of seeds and plant protection products, may face an increase in loan defaults. Silos and processors may lose income from storage or processing of products. Their production facilities will be idle, and fixed costs will not be fully covered. Transport companies, surveyors, export terminals and even seaports can suffer from reduced business volume. Even manufacturers of food packaging can face challenges. Management and business owners are interested in the stable development of their enterprise, but do not always have full information about the existing opportunities for risk management or their transfer. Many large manufacturers diversify production geographically, developing business in several regions of the country, or are engaged in the production of different products. Often, the element of risk management is the vertical integration of the agricultural business, which allows you to maintain the maximum profitability of the enterprise, regardless of fluctuations in prices for agricultural products.In addition, there are additional opportunities for effective risk management. Still, few companies in the agricultural supply chain use price and currency hedging on a regular basis. Although some companies have already experimented with the use of forwards, futures contracts, options and also their combination, however, they have not always received positive experience. This is partly due to a not always complete understanding of such instruments and, in particular, to a misunderstanding of basis risk. Even fewer companies in Ukraine have experience in hedging the risks of their own production volumes or the availability of the necessary raw materials on the market, crop quality insurance or comprehensive income guarantee, which simultaneously covers yield risks, prices and even currency risks. Such instruments are already on the market and their development has a very high potential. In addition, risk management or risk transfer tools can often be used not only for your own peace of mind, but also for effective business development. Some seed and crop protection manufacturers already have experience of "packaging" insurance solutions into their commercial offerings, thereby stimulating increased sales as well as increasing the loyalty of their customers. Unfortunately, not all such programs are simple, transparent and innovative. For example, in world practice there are programs where a farmer, when buying seeds, can insure the crop against the risk of overseeding simply by sending an SMS with the information that he takes from the seed package. If there is no rain for a certain number of days in the region where he opened such a bag and sowed seeds, he will receive a refund, namely a new bag of seeds. Everything is simple and transparent. Unfortunately, such interesting (and useful for agrarians) mechanisms for the formation of loyalty and competitive advantage are still not very common among buyers of agricultural products. It is very likely that they will become much more widely used when new pre-financing mechanisms (for example, crop receipts) help make forward purchases more reliable in terms of compliance by all parties. New banking products for farmers may also be very promising, providing for a reduction in interest rates in the event of a crop failure, a decrease in prices for agricultural products or a poor quality of the grown crop failure. Unfavorable weather affects not only agricultural producers, but also processors and food suppliers. Studies show that a change in average monthly air temperature of just a few degrees can have a significant impact on food sales, especially ice cream, beer and soft drinks. Few food providers are yet aware that solutions exist to protect income from such risks. Moreover, with the use of weather risk transfer solutions, marketing promotions can be structured, for example, providing an additional discount on a product if it rains for several days. Risk management in the agricultural supply chain is a key element in the successful existence of a business.

2. Conclusion

Risk management is reported to be an integral part of manufacturing firms in Uganda. This finding indicates that the manufacturing firms in Uganda are in the right direction as far as ensuring their operating environment is secure enough for the progress and advancement of more and more manufacturing activities. Though not yet perfect to the level of developed countries, the fact that the

manufacturing firms already understand the need to mitigate against possible risks is an indication of their readiness to develop and improve their levels of profitability further. The influence that risk management has on profitability levels of these firms is also an indication that the firms (manufacturing firms) are in the right direction towards guarding against any possible erosion of their profitability levels as they struggle to make better the risk management processes, they already have. Basing on prevailing circumstances as highlighted in the study, it is recommended that the manufacturing businesses in Uganda continue putting forward the risk management processes in all their dealings. This way, the gradual improvement in profitability levels will be expected.

The Risk Management Process

Risk management is a continuous process that is accomplished throughout the life cycle of a system. It is an organized methodology for continuously identifying and measuring the unknowns; developing mitigation options; selecting, planning, and implementing appropriate risk mitigations; and tracking the implementation to ensure successful risk reduction. Effective risk management depends on risk management planning; early identification and analyses of risks; early implementation of corrective actions; continuous monitoring and reassessment; and communication, documentation, and coordination. Acquisition program risk management is not a stand-alone program office task. It is supported by a number of other program office tasks. In turn, the results of risk management are used to finalize those tasks. Important tasks, which must be integrated as part of the risk management process, include requirements development, logical solution and design solution (systems engineering), schedule development, performance measurement, EVM (when implemented), and cost estimating. Planning a good risk management program integral to the overall program management process ensures risks are handled at the appropriate management level. Emphasis on risk management coincides with overall DoD efforts to reduce life-cycle costs (LCC) of system acquisitions. New processes, reforms, and initiatives are being implemented with risk management as a key component. It is essential that programs define, implement and document an appropriate risk management and mitigation approach. Risk management should be designed to enhance program management effectiveness and provide PMs with a key tool to reduce LCC, increase program likelihood of success, and assess areas of cost uncertainty.

The Risk Management Process Model

The risk management process model (see figure 1) includes the following key activities, performed on a continuous basis:

- Risk Identification,
- Risk Analysis,
- Risk Mitigation Planning,
- Risk Mitigation Plan Implementation, and
- Risk Tracking.

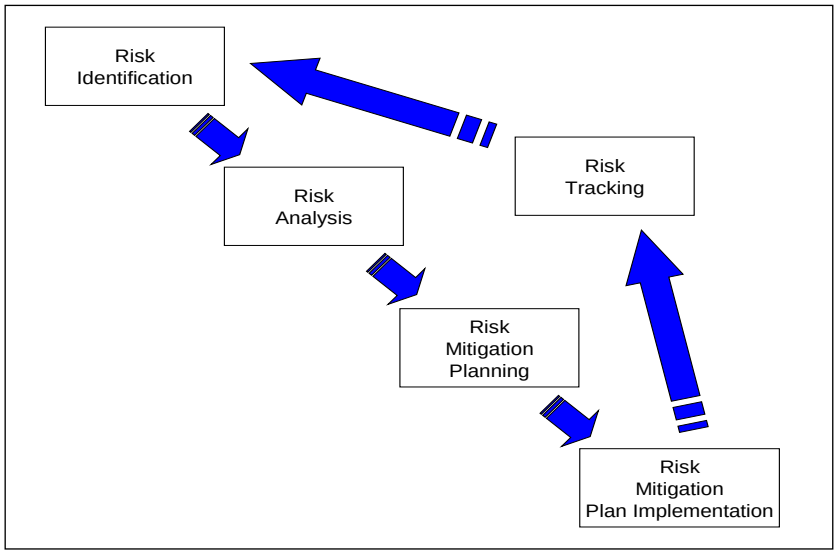

Figure 1. DoD Risk Management Process

Acquisition programs run the gamut from simple to complex procurements and support of mature technologies that are relatively inexpensive to state-of-the-art and beyond programs valued in the multibillions of dollars. Effective risk management approaches generally have consistent characteristics and follow common guidelines regardless of program size. Some characteristics of effective risk management approach are discussed below.

Characteristics of Successful Risk Management Approaches

Successful acquisition programs will likely have the following risk management characteristics:

- Feasible, stable, and well-understood user requirements, supported by leadership / stakeholders, and integrated with program decisions;
- A close partnership with users, industry, and other stakeholders;
- A planned risk management process integral to the acquisition process, especially to the technical planning (SEP and TEMP) processes, and other program related partnerships;
- Continuous, event-driven technical reviews to help define a program that satisfies the user's needs within acceptable risk;
- Identified risks and completed risk analyses;
- Developed, resourced, and implemented risk mitigation plans;
- Acquisition and support strategies consistent with risk level and risk mitigation plans;
- Established thresholds and criteria for proactively implementing defined risk mitigation plans;
- Continuous and iterative assessment of risks;
- The risk analysis function independent from the PM;
- A defined set of success criteria for performance, schedule, and cost elements; and
- A formally documented risk management process.

To support these efforts, assessments via technical reviews should be performed as early as possible in the life cycle (as soon as performance requirements are developed) to ensure critical performance, schedule, and life-cycle cost risks are addressed, with mitigation actions incorporated into program planning and budget projections. As the award of a contract requiring EVM approaches, preparation and planning should commence for the execution of the Integrated Baseline Review (IBR) process in accordance with the Defense Acquisition Guidebook. Chapter 8 addresses risk planning and Risk Management Plans (RMPs).

Top-Level Guidelines for Effective Risk Management

- Assess the root causes of program risks and develop strategies to manage these risks during each acquisition phase.

- Identify as early as possible, and intensively manage those design parameters that critically affect capability, readiness, design cost, or LCC.
- Use technology demonstrations, modeling and simulation, and aggressive prototyping to reduce risks.
- Include test and evaluation as part of the risk management process.
- Include industry participation in risk management. Offerors should have a risk approach as part of their proposals as suggested in this guide to identify root causes and develop plans to manage those risks and should include a draft RMP. Additionally, the offerors should identify risks as they perceive them as part of the proposal. This not only helps the government identify risks early, but provides additional insight into the offeror's level of understanding of the program requirements.
- Use a proactive, structured risk assessment and analysis activity to identify and analyze root causes.
- Use the results of prior event-based systems engineering technical reviews to analyze risks potentially associated with the successful completion of an upcoming review. Reviews should include the status of identified risks.
- Utilize risk assessment checklists (available for all event-based technical reviews) in preparation for and during the conduct of technical reviews. The DAU Technical Reviews Continuous Learning Module (key words: "technical reviews" and course number CLE003) provides a systematic process and access to checklists for continuously assessing the design maturity, technical risk, and programmatic risk of acquisition programs, and provides links to these checklists.
- Establish risk mitigation plans and obtain resources against that plan.
- Provide for periodic risk assessments throughout each program life-cycle phase.
- Establish a series of "risk assessment events," where the effectiveness of risk reduction conducted to date is reviewed. These "risk assessment events" can be held as part of technical reviews, risk review board meetings, or periodic program reviews. These events should include the systems engineering technical reviews, be tied to the IMP at each level, and have clearly defined entry and exit criteria reviewed during IBRs.
- Include processes as part of risk assessment. This would include the contractor's managerial, development, and manufacturing processes as well as repair processes for the sustainment phase.
- Review the contractor's baseline plans as part of the IBR process which includes joint government/contractor evaluation of the inherent risks in the contractor's integrated earned value baseline (work definition, schedule, and budgets).
- Review the contractor's Schedule Risk Assessment (SRA) when provided as part of the IMS data item (DI-MGMT-81650). Review the realism of the contractor's estimate at completion. Assess the overall likelihood of the contractor achieving the forecasted schedule or final costs against the program's constraints.
- Establish a realistic schedule and funding baseline for the program as early as possible in the program, incorporating not only an acceptable level of risk, but adequate schedule and funding margins.
- Clearly define a set of evaluation criteria for assigning risk ratings (low, moderate, high) for identified root causes.
- Determine the program's approach to risk prioritization, commonly presented in the risk reporting matrix discussed in Section 4.2.

Key Activity - Risk Identification

The first key activity in the risk management process is Risk Identification. While in some publications "risk assessment" is used as an umbrella term that includes the primary activities of both risk identification and risk analysis this guide addresses these two critical risk management activities separately in Sections 0 and **Error! Reference source not found.**, respectively.

Purpose

The intent of risk identification is to answer the question "What can go wrong?" by:

- Looking at current and proposed staffing, process, design, supplier, operational employment, resources, dependencies, etc.,

- Monitoring test results especially test failures (readiness results and readiness problems for the sustainment phase),
- Reviewing potential shortfalls against expectations, and
- Analyzing negative trends.

Risk identification is the activity that examines each element of the program to identify associated root causes, begin their documentation, and set the stage for their successful management. Risk identification begins as early as possible in successful programs and continues throughout the program with regular reviews and analyses of Technical Performance Measurements (TPMs), schedule, resource data, life-cycle cost information, EVM data/trends, progress against critical path, technical baseline maturity, safety, operational readiness, and other program information available to program IPT members.

Tasks

Risk can be associated with all aspects of a program, e.g., operational needs, attributes, constraints, performance parameters including Key Performance Parameters (KPPs), threats, technology, design processes, or WBS elements. Consequently it is important to recognize that risk identification is the responsibility of every member of the IPT, not just the PM or systems engineer. Examination of a program is accomplished through decomposition into relevant elements or areas. Decomposition may be oriented to requirements, processes, functional areas, technical baselines, or acquisition phases. Another method is to create a WBS as early as possible in a program for a product-oriented decomposition, which is particularly useful in identifying product and some process-oriented risks. Other means, such as a process-oriented framework, would be required to sufficiently illuminate process-based root causes, which could be tracked via the WBS structure to view impacts to schedule, resource loading, etc. To identify risks and their root causes, IPTs should break down program elements to a level where subject matter experts (SMEs) can perform valid identification by WBS or IMS line-item number. The information necessary to do this varies according to the life-cycle phase of the program. A program risk assessment checklist is available via the DAU Technical Reviews Continuous Learning Module (key words: "technical reviews;" course number CLE003). During decomposition, risks can be identified based on prior experience, brainstorming, lessons learned from similar programs, and guidance contained in the program office RMP (see Section **Error! Reference source not found.**). A structured approach describes each WBS element in terms of sources or areas of risk. MIL-HDBK-881, "Work Breakdown Structures for Defense Materiel Items," serves as the basis for identifying the first three levels of the program WBS, and developing the contract WBS. The examination of each element and process against each risk area is an exploratory exercise to identify the critical root causes. The investigation may show that risks are inter-related. WBS product and process elements and industrial engineering, manufacturing and repair processes are often sources of significant root causes. Risks are determined by examining each WBS element and process in terms of causes, sources, or areas of risk. When EVM is applied on a contract it can help identify WBS program elements that are experiencing issues. This information can be used to help prioritize WBS elements that may contain unidentified risks.

Identification of Root Causes

Program offices should examine their programs and identify root causes by reducing program elements to a level of detail that permits an evaluator to understand the significance of any risk and identify its causes. This is a practical way of addressing the large and diverse number of risks that often occur in acquisition programs. For example, a WBS level 4 or 5 element may be made up of several root causes associated with a specification or function, e.g., potential failure to meet turbine blade vibration requirements for an engine turbine design. Root causes are identified by examining each WBS product and process element in terms of the sources or areas of risk. Root causes are those potential events that evaluators (after examining scenarios, WBS, or processes) determine would adversely affect the program at any time in its life cycle.

An approach for identifying and compiling a list of root causes is to:

- List WBS product or process elements,

- Examine each in terms of risk sources or areas,
- Determine what could go wrong, and
- Ask "why" multiple times until the source(s) is discovered.

The risk identification activity should be applied early and continuously in the acquisition process, essentially from the time performance and readiness requirements are developed. The program office should develop and employ a formalized risk identification procedure, and all personnel should be responsible for using the procedure to identify risks. Specific opportunities to identify risks (e.g., at event-driven technical reviews) and explore root causes against objective measures (e.g., meeting the entry criteria for an upcoming technical review, requirements stability, technical maturity, software lines of code and reuse ratios, critical paths or near critical paths) should not be overlooked. If technical reviews are schedule, vice event driven, their usefulness as risk assessment tools can be impacted, and the full benefits of risk assessment may not be achieved. The early identification and assessment of critical risks allows for the formulation of risk mitigation approaches and the streamlining of both the program definition and the Request For Proposal (RFP) processes around those critical product and process risks. Risk identification should be done again following any major program change or restructure such as significant schedule adjustment, requirements change, or scope change to the contract.

Typical risk sources include:

- **Threat.** The sensitivity of the program to uncertainty in the threat description, the degree to which the system design would have to change if the threat's parameters change, or the vulnerability of the program to foreign intelligence collection efforts (sensitivity to threat countermeasure).
- **Requirements.** The sensitivity of the program to uncertainty in the system description and requirements, excluding those caused by threat uncertainty. Requirements include operational needs, attributes, performance and readiness parameters (including KPPs), constraints, technology, design processes, and WBS elements.
- **Technical Baseline.** The ability of the system configuration to achieve the program's engineering objectives based on the available technology, design tools, design maturity, etc. Program uncertainties and the processes associated with the "ilities" (reliability, supportability, maintainability, etc.) must be considered. The system configuration is an agreed-to description (an approved and released document or a set of documents) of the attributes of a product, at a point in time, which serves as a basis for defining change.
- **Test and Evaluation.** The adequacy and capability of the test and evaluation program to assess attainment of significant performance specifications and determine whether the system is operationally effective, operationally suitable, and interoperable.
- **Modeling and Simulation (M&S).** The adequacy and capability of M&S to support all life-cycle phases of a program using verified, validated, and accredited models and simulations.
- **Technology.** The degree to which the technology proposed for the program has demonstrated sufficient maturity to be realistically capable of meeting all of the program's objectives.
- **Logistics.** The ability of the system configuration and associated documentation to achieve the program's logistics objectives based on the system design, maintenance concept, support system design, and availability of support data and resources.
- **Production/Facilities.** The ability of the system configuration to achieve the program's production objectives based on the system design, manufacturing processes chosen, and availability of manufacturing resources (repair resources in the sustainment phase).
- **Concurrency.** The sensitivity of the program to uncertainty resulting from the combining or overlapping of life-cycle phases or activities.
- **Industrial Capabilities.** The abilities, experience, resources, and knowledge of the contractors to design, develop, manufacture, and support the system.
- **Cost.** The ability of the system to achieve the program's life-cycle support objectives. This includes the effects of budget and affordability decisions and the effects of inherent errors in the cost estimating technique(s) used (given that the technical requirements were properly defined and taking into account known and unknown program information).

- **Management.** The degree to which program plans and strategies exist and are realistic and consistent. The government's acquisition and support team should be qualified and sufficiently staffed to manage the program.
- **Schedule.** The sufficiency of the time allocated for performing the defined acquisition tasks. This factor includes the effects of programmatic schedule decisions, the inherent errors in schedule estimating, and external physical constraints.
- **External Factors.** The availability of government resources external to the program office that are required to support the program such as facilities, resources, personnel, government furnished equipment, etc.
- **Budget.** The sensitivity of the program to budget variations and reductions and the resultant program turbulence.
- **Earned Value Management System**. The adequacy of the contractor's EVM process and the realism of the integrated baseline for managing the program.

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