

Risks Management & Opportunity NovaLT5 Product Revitalization

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ABSTRACT: *NovaLT5 gas turbine is a new alternative for a wide range of small power generation applications. The NovaLT5 is an improved version of the GE5 and it is built on the technology and innovation of last successful NovaLT16.*

The GE5 was already tested in different applications around the world and evolved to become the more efficient NovaLT product. GE5 development was put on hold in 2005; after ten years the project has been restarted due to the need of 5 MW gas turbine portfolio fulfillment.

NovaLT5 has the peculiarity of high exhaust temperature which is particularly advantageous for Heat Recovery System (HRS) applications.

This paper presents a case study of "Risk & Opportunity Management" applied to revitalization of the supply chain, manufacturing processing and tooling, updating of engineering documentation and assessment to compliance with actual legislations. Sales opportunities are balanced and traded-off with engineering effort and manufacturing investment.

I. INTRODUCTION

NovaLT5 is 5.6 MW engine (single shaft) for power generation application, that is a gas turbine electrical generator driven. This gas turbine, thanks to the Heat Recovery System, produces high temperature steam by exhausted gases that reaches 85% of efficiency.

BHGE decided to expand gas turbine portfolio with a 5 MW machine, redesigning the "GE5" engine, already proved in the past and retired in 2005.

After the NovaLT16 launch, the market analysis of last years revealed the possibility to confirm our excellence in GT up to 20MW, both for power generation and for mechanical drive applications.

The "Risk & Opportunity Management", applied to NovaLT5 revitalization, highlights influence of manufacturing processing, tooling, updating of engineering documentation and assessment to compliance with actual legislation. Opportunities are balanced and traded-off with engineering effort and manufacturing investment.

Decision to re-launch the production has been taking by analysis the balance between market size and manufacturing and engineering investment.

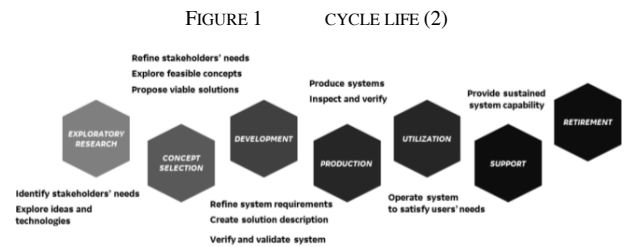
The study started from experience, matured with GE5 fleet along with related Lesson Learned, field experiences and all other aspects improved into the new product, according to the Product Line Management (PLM) discipline.

II. RISK ANALYSIS

In our organization the Systems Engineer/Technical Leader is responsible for assessing the technical regulations

and risks with global supply chain, generating the ATQ (Approval to Quote) document and providing technical content for the application data and performance tools.

As already mentioned, GE5 life cycle has been completed and succeeded by the new and improved NovaLT5.



The new design has been obtained going through the Life Cycle phases, shown above (Fig. 1), already followed for the GE5 and retailored against the new technologies and stakeholder's requirements.

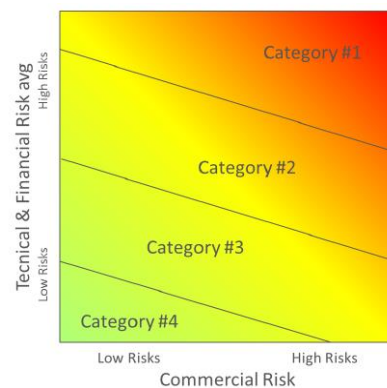
Risk & opportunity management is performed along the whole life steps of the product (see Fig. 2 below).

FIGURE 2



Diagram shown in fig.3 provides qualitative indication regarding program Risk category (from #1 to #4).

FIGURE 3 (1)



Specific tailored framework is coupled to each program category (figure 4).

FIGURE 4 PRODUCT DEVELOPMENT PROGRAMS (1)



Risk can be viewed under three different perspectives:

- **Technology risks:** project complexity, initial product Technology Readiness Level (TRL) and Manufacturing Readiness Level (MRL)
- **Financial risk:** project budget
- **Commercial risks:** commercial uncertainties and litigation possibilities.

Technical risk considered Feasibility and compatibility to revitalize GE5 product to take leverage on new available technologies: items redesign to reduce manufacturing cycle costs and supplier cost, to take into account new market requirements, to fix issues.

In this case, two different risk levels were assigned to the two main sub-systems:

- Gas Turbine Engine (Flange-to-Flange): level 2 because very similar the previous one.
- Gas Turbine Package (enclosure, driven and auxiliary): level 3, because totally different from the previous GE5.

Financial risk evaluated the cost of investment coming from market analysis.

Cost of Investment plan had a differentiated payback for package, engine and service unit.

Result a medium risk.

Commercial risks defined the strategy to penetrate into the market looking at the most crucial parameters as CAPEX (Capital Expense, basically the product price), Mean Time Between Maintenance, Modular design, low combustion emissions, high Combined Heat and Power (CHP) efficiency.

Result a medium/high risk

III. OPPORTUNITY ANALYSIS

GE5 redesign effort has been motivated by LT16 market analysis, that highlighted the need of a competitive 5 MW gas turbine, aligned with new technologies for which the GE5 was obsolete at this point.

To confirm the market analysis suggestion, the new idea, not yet existing product, has been proposed into the market and captured enough acquirers to justify the required cost of investment.

The first unit sold requested an agreement with the customer for a longer lead time with respect to its need.

Thanks to this achievement there was the chance to develop the technical missing content.

The outcome of this step allowed to lower the lead time to the standard value for this market segment.

FIGURE 5 RISK CRITERIA

Risk Type	Risk Criteria
Commercial	High risks when: <ul style="list-style-type: none"> Major or new market impact or opportunity for significant revenue and margin creation Significant Product Line addition or enhancement Major customer or partner involvement and/or funding Major Company-wide launch event with broad commercial launch and commercialization plan Significant exposure and impact to market reputation Global applicability with multiple regions involved
	Medium risks when: <ul style="list-style-type: none"> Multiple customers Serving existing market segment Complex commercialization with significant commercial launch Significant expense or revenue impact Multi-region impact
	Low risks when: <ul style="list-style-type: none"> Limited number of customers Product line unique offering, or an extension or modification of an existing product No complex commercialization Region specific application Nominal expense or revenue impact
Technical	High risks when: <ul style="list-style-type: none"> Product with all or > 50% new design of systems, subsystems, or components Limited testing or operating experience Major technical feasibility uncertainties and execution risks identified No or very limited existing design data available
	Medium risks when: <ul style="list-style-type: none"> 25% to 50% new component design, mostly based on similar existing successful designs (e.g. scaled designs) Existing test and operating experience Technical design data exists Minor technical feasibility uncertainties identified
	Low risks when: <ul style="list-style-type: none"> Similar design or product upgrade based on previous experience at different scale or conditions, typically <25% new components or new design required Significant test and operating experience No or easily manageable technical feasibility uncertainties Technical design data readily available
Financial	High risks when: project budget is $\geq 20\%$ of Product Line budget
	Medium risks when: project budget is $\geq 10\%$ and $<20\%$ of Product Line budget
	Low risks when: project budget is $<10\%$ of Product Line budget

IV. CONCLUSIONS

Thanks to a pondered balance between potential risks and market opportunities, it has been possible to realize a successful gas turbine without extreme economical exposure: the risks, technical, financial and commercial, have been evaluated and market opportunities validated through the sale of the idea and not of the already existing product. The “balanced” mitigation approach proved effective in term of customer acceptance.

REFERENCES

- [1] Product Development process - BHGE-QUA-038 (EN) Rev. 1.0
- [2] Systems Engineering for Gas Turbines Life Cycle Management: a tailored approach - EMEASEC 2018 / TdSE 2018