

THE USE OF OPTIMIZATION SOFTWARE IN SMALL AND MEDIUM-SIZED ENTERPRISES, CASE OF BAC GIANG PROVINCE

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ABSTRACT:

During the COVID-19 pandemic, small and medium-sized enterprises (SMEs) have been in extreme situation facing prolonged shutdowns across industries and supply chain breakdowns. Turning threats into opportunities, these issues are the chance for SMEs to innovate and improve their performance. Operations optimization is an effective solution to help SMEs lower costs and increase profit. Most of Fortune 500 companies have optimized their operations with notably successful stories. For SMEs in Vietnam, operations optimization can be seen as an approach to lean operations and grow. This study presents an insight about how operations optimization is in practice, with samples from SMEs in Bac Giang province. The study also identifies and analyzes the current rate of operations optimization and the factors affecting the decision of SMEs to use optimization software. Among studied factors, limited budget and information access are the most critical factors.

Keywords: operations optimization, software, optimization software, small and medium-sized enterprises, Bac Giang province.

1. Operations optimization

Since the late 1990s, companies worldwide gradually adopt computer-based optimization to facilitate business control, reporting and decision making. With the help of operations optimization, managers can obtain benefits in more effective decisions, better coordination and control, and higher productivity.

Operations optimization helps decision makers to quickly find the best inventory mix, shortest project schedule, optimal utilization of manpower, most desirable use of plant machinery, highest-producing marketing campaigns, most fruitful expansion, modernization, installation of technology, etc. Minimizing cost, time or resource use, or maximizing outputs can be sought from running the optimization software.

Theoretically, any operation in any business can be improved using suitable algorithms, usually embedded in a respective optimization software. Below are some instances of using optimization to improve the

efficiency in design and/or operations in various field, from manufacturing flow to logistics network, from wind design to material cutting, etc.

Dossou et al [1] focuses on the production flow optimization through collaborative robots (cobot) and autonomous mobile robots (AMR) in the frame of industry 4.0. The analysis of the company's classical production processes generally pointed out the existence of added and non-added value through each process. Lean manufacturing concepts contribute to the elimination of these non or low added values in the company production flows. An example based on the electronic card production domain is demonstrated. Non-added values in the manufacturing system detection and elimination by integrating new technologies and tools help improve overall performance around 30% of time, 42% of workforce cost reduction.

The design optimization of the blades is the most important stage to maximize efficiency production of wind turbine. Aerodynamic characteristics of the

blades are critical components that have a large influence on the performance of the turbine. In order to produce more efficient, sustainable-clean energy, accurate prediction of wind turbine design parameters is needed. An optimal model of aerodynamic characteristics through maximizing lift coefficient and the lift to drag ratio by optimizing the blade shape was built in [2], by combining computational fluid dynamics (CFD) and genetic algorithms (GA) by Dakota (Design and Analysis toolKit for Optimization and Terascale Applications) software.

Tynchenko et al [3] develop a prototype of a software control system for electron beam welding, with optimization of the electron beam output, which allows control at all stages of the technological process of thin-walled structures welding. The model considers the dynamics of the thermal process in the welded joint zone, depending on the electron beam input mode, the product geometric dimensions, and the technological parameters used in the welding process. Welding parameter is optimized during electron-beam welding in order to prevent defects arising at this stage (microcracks, voids, lack of penetration, sagging of the seam).

Building Energy Modeling & Simulation (BEMS) software tools allow the user to readily analyze a buildings energy performance using historical weather data, occupancy profiles, construction materials, electricity rates, and Heating, Ventilation, & Air-Conditioning (HVAC) system specifications. The standard process in the United States commercial building construction industry is currently to use modern BEMS tools for sizing HVAC equipment, lifecycle costs, and code compliance analyses. Barber and Krarti [4] review applications of multi-objective optimization approaches for design, control, and the combination of both design and control of a single element or a set of integrated building systems using modeling and simulation tools. Reviewed studies show significant annual energy savings and peak load shifting potential for integrated system optimization within buildings. Moreover, optimization-based building energy modeling and simulation tools would be beneficial for designing and operating a built environment that is resilient and sustainable.

A key aspect for good logistics management is the distribution network, where the location of the network components like distribution centers plays a key role. Rodríguez et al [5] propose a solution for selecting two locations from among four possible sites for

construction of distribution centers for a company in the metalworking industry, aimed at minimizing operating costs through the design of a logistics distribution network, using GUSEK software as a tool. The aspects taken into consideration include vehicle capacity, the costs associated with opening a distribution center, types and volume of the products to be shipped, costs associated with the travel distances, the production capacity of the factories, and customer demand, among others. Execution of the model produces the best locations for the distribution centers and the types of vehicles to be used based on their capacity and the optimal routes for transporting goods.

Tung [6] provides a brief review the features of around thirty optimization software that enterprises can utilize to improve the efficiency of daily operations in manufacturing environment. Though it is far from completed, the review provides a rough understanding of some operations optimization that are beneficial to the software users. They include inventory control, material cutting, job-shop schedule, load stacking, vehicle routing. Overall features of the optimization software are they seek to allocate scarce available resources to obtain the optimal objective value (whether it is cost, revenue, service level, etc.) satisfying all the system requirements.

Traditionally, a software user (whether individual or institution) had only one option: purchase a license from vendors and install the software locally. This is a logical method for processes with intense computational activity requirements. The downside of licensing is the capital investment and complex deployment. The user must pay for the software up front; and manage software upgrades, fixes, and maintenance costs.

Another option is hosted software. In this model, the customer purchases and owns the software, but it is installed remotely at a data center where either physical or virtualized servers that the company owns, leases, or finances are set up. The operations software is implemented much like it would be done on-premise at the buyer's own facilities. This model offers the services of a highly secure data center with multisite backup. On the downside, hosted solutions can be expensive and access is lost when Internet service is unavailable.

Nowadays, cloud computing has changed the situation. Buyers can now use applications that are not permanently installed on the company's network. In the software as a service (SaaS) distribution model,

software access is provided via the Internet. It is a pay-as-you-go method that allows the customer to use software as needed, without having to install it or purchase a license. This promotes accessibility to more data, partner collaboration, operational scalability, and visibility. SaaS applications can be accessed securely by multiple customers, each of whom typically pays a subscription fee. Cloud-based solutions make the use of software more affordable for smaller organizations and that is leading to greater adoption.

With such developments in information technology, various optimization software now becomes handy to any business of any size in any sector.

2. Vietnam small and medium-sized enterprises

Small and medium-sized enterprises (SMEs) are enterprises with low scale in terms of workforce, capital, or turnover. They can be divided into three sub-categories based on their size: micro enterprises (less than 10 employees), small enterprises (less than 50-100 employees) and medium enterprises (less than 100-200 employees), as in Vietnam. [7]

SMEs, which are the majority in the country's private sector, play a vital role in Vietnam economy. Of the total 518,000 enterprises registered in 2017, around 500,000 were SMEs. As mentioned by the principal country economist from the Asian Development Bank (ADB) Mr. Nguyen Minh Cuong, SMEs contribute around 47 per cent of the country's GDP and 40 per cent of the nation's budget, and about nine million jobs have been generated by SMEs. [8]

SMEs in Vietnam are popular in the fields of service trade, repair, providing simple ancillary services to large enterprises, small production with simple technology... However, according to the Vietnam Institute for Economic and Policy Research, despite improvement in their capacity in past decades, nearly 56% of SMEs do not have sufficient knowledge in business and corporate governance, financial management, and business law.

They operate in the same environment as the large-scale industries, but lack proper business management practices, skilled labor, financial skills, performance monitoring of business operations, and often have unskilled or incompetent management. They are also disassociated with the benefits of adequate capital that their larger counterparts enjoy.

According to Mr. Tran Ngoc Liem, most of SMEs are still hanging around in the domestic market. Only 3% of micro enterprises, 4% of small enterprises and

nearly 9% of medium-sized enterprises have customers from abroad. The smaller the enterprises, the harder it is to access capital; the more difficult loan procedures and conditions; It is also difficult for SMEs to access land and enter industrial parks because they do not meet the conditions. In addition, SMEs also face other barriers such as personnel recruitment, inspection, administrative procedures, informal costs, etc. [9]

These challenges can be paralyzing, leaving them with little flexibility and subsequently lower efficiency compared to bigger firms, due to their inexperienced organizational structures. They have little power compared to larger and more established firms. Therefore, they cannot be as challenging as larger firms, concerning product quality price. Consequently, SMEs are often more susceptible and have to find more competitive advantage sources.

Digital transformation opens a valuable opportunity to SMEs to modernize their operations and management. The wave of lean manufacturing in the last few decades emphasize the role of operations optimization, specially facilitated by information technology though application of optimization software.

Tung [10] studies the interests of SMEs on optimizing different fields of operations. Their highest interest is on production management optimization at 46.7%. In the second position are optimization on finance and investment, on project management, and on human resources management, at 40%. Other operational areas such as purchasing, logistics, machinery or marketing management attract lowest interest to the production SMEs. Certainly, there is a big gap from interest to actual use of optimization as it may trigger a lot of changes from the business.

3. SME application of optimization software

To answer the question how operations optimization is utilizing in SMEs, we can rely on data from a small survey conducted in 2021 of 50 SMEs in Bac Giang, a province in the northern Vietnam.

The participating companies operate in various sectors, such as mechanical manufacturing, civil construction, building materials production, wood processing and furniture making, etc. The compositions include newly established (up to 3 years old) accounting for 30%, 3 to 10 years old (20%), 10 to 20 years old (40%), and more than 20 years in business (10%). Regarding the size of the companies, most are micro enterprises (35%) and small enterprises (50%)

whist only 15% are of medium size, based on numbers of employees.

3.1. Current use and intention

The rate of using optimization software among participating companies are quite low. Survey data show that only 25% of the surveyed SMEs use some types of optimization software in their operations. The major 75% of surveyed SMEs have no such software application in their companies. The potentials for further dissemination of optimization software in the SMEs thus are very promising. There is a huge market for the software application developers and/or suppliers to grasp.

Regarding intention to use an optimization software in the near future, the answer is diverse between those already use some optimization software and those haven't used any yet, as in Table 1.

Table 1. Intention of future use

Company	Will use	Will not use
Already use	100%	0%
Not yet use	67%	33%

All current users (100%) indicate that they continue to invest in optimization software, clearly show that they have recognized great benefits from the software use that surpass the costs to deploy.

Among those have not been used any kind of such software, two third (66.7%) plan to optimize their operations in the near future, and the rest 33.3% continue to reject using some types of optimization software. It is interesting to find out reasons behind this rejection.

3.2. Promoting application

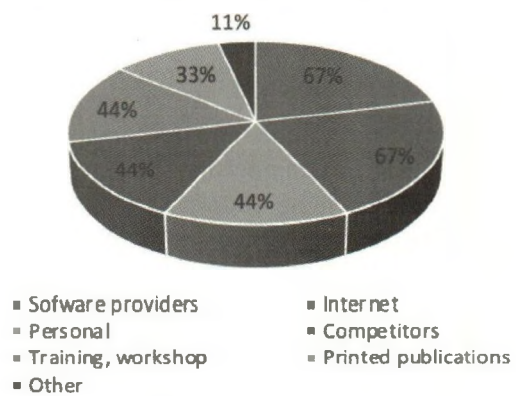
Only 40% of respondents confirmed that they have heard/known about any optimization software for business. It means that the majority (60% SMEs surveyed) are not aware of the existence of optimization software for business. This is quite disappointed since management software (like accounting) are widely used in enterprises for years. The low awareness level partially answers why the optimization software application rate is quite low.

This fact has an implication that broad awareness raising campaigns to feed information to Vietnam enterprises, specially, the top management, are needed. With better awareness, higher application rate of optimization tools can be achieved and more enterprises can improve their operations efficiency.

For those who know or use an optimization

software, the two most important sources for their awareness are software providers and the Internet. Ranked next include information access through personal approaches, other enterprises in the same sector, and through trainings and workshops. Printed materials like publications, brochures, leaflets, etc. only play a modest role. Thus, more active information push from the software providers directly to SMEs or indirectly through the Internet will have positive impact.

Fig 1. Source of information access



From financial aspect, the number of companies ready to pay for the use of optimization software is rather low. It can be interpreted as, to the SMEs managers, the perceived benefits from such software application seem not overweighted the investment cost. Sixty percent of companies which already use some type of optimization software reply that they pay and will continue to pay for the software use, the rest 40% don't want to pay for further use of optimization software. However, among the companies that have not been using any optimization software, only 6.7% reply that they will financially invest on the software in the future, while the majority 93.3% keep rejecting payment for use. The differences between two company categories are considerable and interesting.

Table 2. Investment readiness

Company	Willing to pay	Not willing to pay
Already use	60%	40%
Not yet use	6.7%	93.3%

Limitation in the financial resource can be the reason for this low level of investment readiness. While it is really a constraint to SMEs in general, the role of awareness raising becomes more important to

help them realize the relatively low cost of investing on optimization software and much higher benefits due to business efficiency improvement.

Solving those issues will certainly promote the use of optimization software in SMEs. The top management awareness of optimization software needs to be improved so that decisions can be made on procurement and application of the software. Dealing with information access limitation may help boost the optimization software application and lessen the perceived financial barrier as well.

4. Conclusions

This paper introduces the importance of operations optimization in practice with enterprises, specially, SMEs. Optimization can be seen in various aspects of the business and helps improve the business efficiency and effectiveness. Some examples of optimization application studies are reviewed, with greatly benefits realized to the enterprises.

This paper also presents some insights from a small study of manufacturing SMEs in Bac Giang province,

Vietnam regarding how they know and use optimization software in their companies.

It turns out that only a small percentage of SMEs are aware and actual use of optimization software. Investment willingness for optimization software is very low, with only 6.7% of new users ready to pay for an optimization software implementation. Given the fact that there are optimization software that are low cost or even free-of-charge available in the market, this misunderstanding of budget limitation needs to be clearly communicated to the SMEs leaders.

Information access and awareness raising for top management seem to be proper solutions to promote the use of optimization software to improve SMEs efficiency.

Further study may be needed to provide a clearer and more detailed picture of actual situation at SMEs. This may include studies on the benefits of implementing optimization software in different operations, or on optimization software features that SMEs needs the most ■

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ỨNG DỤNG PHẦN MỀM TỐI ƯU HÓA TẠI CÁC DOANH NGHIỆP NHỎ VÀ VỪA: NGHIÊN CỨU TẠI TỈNH BẮC GIANG

● TS. **ĐẶNG VŨ TÙNG**

Trường Đại học Bách khoa Hà Nội

TÓM TẮT:

Trong đại dịch Covid-19, các doanh nghiệp nhỏ và vừa (DNNVV) ở trong tình trạng vô cùng khó khăn khi phải đối mặt với tình trạng đóng cửa hoạt động sản xuất kéo dài và đứt gãy chuỗi cung ứng. Biến các mối đe dọa thành cơ hội, đây cũng là thời điểm để các doanh nghiệp thực hiện đổi mới, nâng cao hiệu quả kinh doanh. Tối ưu hóa hoạt động là một cách hiệu quả để cắt giảm chi phí kinh doanh và tăng lợi nhuận. Hầu hết các công ty trong danh sách Fortune 500 đã và đang sử dụng tối ưu hóa, với hàng loạt những câu chuyện thành công. Đối với các DNNVV tại Việt Nam, tối ưu hóa tác nghiệp có thể được coi là một cách tiếp cận hướng tới tinh gọn và duy trì sự tồn tại. Bài báo này cung cấp một cái nhìn về hiện trạng tối ưu hóa tác nghiệp trong thực tế doanh nghiệp, với các mẫu từ các DNNVV ở tỉnh Bắc Giang. Tỷ lệ ứng dụng tối ưu hóa và các yếu tố ảnh hưởng đến quyết định sử dụng phần mềm tối ưu hóa đã được xác định và phân tích, trong đó hạn chế ngân sách đầu tư và khả năng tiếp cận thông tin được coi là quan trọng nhất.

Từ khóa: tối ưu hóa tác nghiệp, ứng dụng phần mềm, phần mềm tối ưu, doanh nghiệp nhỏ và vừa, Bắc Giang.