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FINANCIAL BUSINESS FEASIBILITY OF BIOMEDICAL IMPLANT PRODUCTION USING ADDITIVE MANUFACTURING PROCESS

KELAYAKAN BISNIS FINANSIAL PRODUKSI IMPLAN BIOMEDIS DENGAN MENGGUNAKAN PROSES MANUFAKTUR ADITIF

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ABSTRACT

The market size of medical implant in Indonesia is estimated around US$ 20 million in 2021 and will reach a value US$ 36,67 million by 2026 with 15.2% CAGR. Furthermore, the total medical implant market size in Asia was estimated US$ 7.302 million and is expected to growth become US$ 10,610 million in 2026. Those number bring medical implant business become very attractive market potential to be developed and produced in Indonesia, to meet local demand as well as for Asia market. The feasibility study is carried out using capital budgeting method by analyzing result of net present value (NPV), internal rate of Return (IRR), payback period (PP) and profitability index (PI). In addition, sensitivity analysis is performed to assess the susceptibility of the NPV result toward change in the variables input. Based on the analysis, the investment project is feasible and accepted where the NPV is USD 6.252.653, IRR 35%, and payback period 3,7 years. Sensitivity analysis also reveals that this project exhibits a relatively low susceptibility to variable uncertainty where NPV is still positive when subjected to various variables changes. Sales volume and selling price are variables that greatly influence into the change of NPV result into ±37% variance where 20% increase of sales volume in each period will dramatically increase the NPV into USD 8.584.201. Meanwhile 20% reduction of sales volume will reduce the NPV into USD 3.919.321.
Keywords: *Additive Manufacturing, Biomedical Implant, Feasibility Study, Sensitivity Analysis,*

ABSTRAK

Ukuran pasar implan medis di Indonesia diperkirakan sekitar US$ 20 juta pada tahun 2021 dan akan mencapai nilai US$ 36,67 juta pada tahun 2026 dengan CAGR 15,2%. Selain itu, total ukuran pasar implan medis di Asia diperkirakan mencapai US$ 7,302 juta dan diperkirakan akan tumbuh menjadi US$ 10,610 juta pada tahun 2026. Angka-angka tersebut menjadikan bisnis implan medis sebagai potensi pasar yang sangat menarik untuk dikembangkan dan diproduksi di Indonesia, baik untuk memenuhi kebutuhan lokal maupun untuk pasar Asia. Studi kelayakan dilakukan dengan menggunakan metode capital budgeting dengan menganalisis hasil net present value (NPV), internal rate of return (IRR), payback period (PP) dan profitability index (PI). Selain itu, analisis sensitivitas dilakukan untuk menilai kerentanan hasil NPV terhadap perubahan variabel-variabel yang menjadi input. Berdasarkan hasil analisis, proyek investasi ini layak dan dapat diterima dengan nilai NPV sebesar USD 6.252.653, IRR 35%, dan payback period 3,7 tahun. Analisis sensitivitas juga menunjukkan bahwa proyek ini menunjukkan kerentanan yang relatif rendah terhadap ketidakpastian variabel dimana NPV masih positif ketika mengalami berbagai perubahan variabel. Volume penjualan dan harga jual merupakan variabel yang sangat berpengaruh terhadap perubahan hasil NPV dengan varians ±37% dimana peningkatan volume penjualan sebesar 20% pada setiap periode akan meningkatkan NPV secara drastis menjadi USD 8.584.201,-. Sementara itu, penurunan volume penjualan sebesar 20% akan menurunkan NPV sebesar USD 3.919.321.
Kata Kunci: Manufaktur Aditif, Implan Biomedis, Studi Kelayakan, Analisis Sensitivitas.

INTRODUCTION

Indonesia has enormous dependency with imported product of medical device to fulfil local demand. Refer to BPPT data on 2021, 92% of medical device is import product with total 63.771 licenses and only 2% of the medical devices with 5.545 licenses produced locally (BPPT, 2021). According to data from the International Trade Administration at the US Dept. of Commerce, the market size of the Indonesian medical device and lab equipment is expected to reach US$3.85 billion in 2022 from $2.85 billion in 2019 (ITA, 2022). One of the examples

of medical device's applications are biomedical implant that used for orthopedic & prosthetic implant and teeth implants. Refer to Fitch Solution data, the market of orthopedic & prosthetic implant in Indonesia is around US$ 20 million in 2021. The number of the orthopedic market expected will expand at compound annual growth rate (CAGR) 15.2% between 2021-2026 and will reach a value US$ 36,67 million by 2026 (Fitch Solution, 2022).

Table 1. Asia Orthopedics & Prosthetics Market Estimation 2021 - 2026

Asia Medical Device Market (USD Million)	2021e	2022f	2023f	2024f	2025f	2026f
Orthopedics & Prosthetic Total Sales	7.302	7.341	8.039	8.940	9.734	10.610

(Source: Fitch solution, 2022)

Looking at the regional market as described in Table 1, the total medical implant in Asia was estimated US$ 7.302 million on 2021 and is expected to growth become US$ 10,610 million in 2026 (Fitchsolution, 2022). So, this growth potential creates an attractive market opportunity to develop and produce medical implant products in Indonesia, meeting local demand as well as penetrating the export market and makes a viable business opportunity for the company.

In the context of manufacturing process and technology, there are several methods of manufacturing medical implant such as casting, machining, powder metallurgy. Those process are categorized as conventional method whereas major finishing process are required and typically produces high scrap rate during production. Recently there is a new technology so called additive manufacturing that disrupt conventional process and it has been commercially and widely used to produce medical implants materials. Additive manufacturing offers many advantages such as net to shape product, capability to produce complex geometry with high quality material, better production yield (Li, 2016), possibility to have personalized 3D printed implants for optimal implant fit based on patient needs and better biocompatibility due to porous structure.

Those market potential of medical implant and value proposition of additive manufacturing become opportunity to be further studied in this research paper in the aspect of financial feasibility using capital budgeting and also NPV sensitivity analysis where the result will be used as parameters to make decision for this investment project.

Literature Review

2.1 Additive Manufacturing (AM) in Medical Application

The main value proposition of AM in orthopedic and teeth implant is to provide better personalized treatment for patient with efficient and accurate digital design and manufacturing process. In addition, porous surface of AM parts provides faster patient recovery and better biocompatibility (Chunhua Sun, 2020). At this present, AM in medical device or specifically in orthopedic implants and dentistry is widely used and stepping into industrialization. Medical implant is the major aspect for AM technology. In clinical treatment, implant is one of the treatment methods for skeletal muscle system. It can replace joint, bone, cartilage, or musculoskeletal system in whole or part to avoid the mismatch of prosthesis size. Figure 1 show some metal medical implant produced by AM.

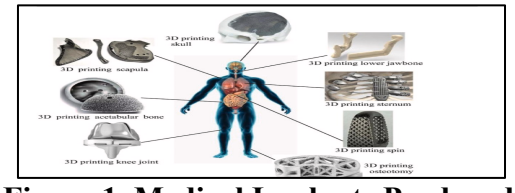

Figure 1. Medical Implants Produced using AM (Khanish Gupta, 2023)

Implant produced by AM has the advantage of short cycle, low cost, customization, porous structure that create bone integration of implant. Some AM implant that launched and widely available in the market such as knee joint, meniscus tissue, spine, hip joint, bracket, teeth, etc. (Chunhua Sun, 2020). The surgery result using AM implant hip joint (showed that the patient could walk independently and the implant hip joint recovered very well and compatible with human interface tissue. (Wong, 2015).

2.2 Investment Decision

Capital budgeting is predominantly used to evaluate the feasibility of the investment project such as building new plant. As part of capital budgeting, a company might assess a prospective project's lifetime cash inflows and outflows to determine whether the potential returns would meet an indicator target / variable. Several variables that used as indicators are Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP) and profitability Index.

The Net Present Value (NPV) can be defined as the present value of the future cash flows. It discounts by the appropriate cost of capital and reduces by the initial project expenditures. Project with positive NPV will be accepted and project with negative NPV will be rejected. IRR is the discount rate which is the set of the present value of a project equal to the investment value. In other words, the IRR is the discount rate that generate the NPV to zero. The acceptance of rejection of this investment proposal is by comparing IRR with the required interest rate (required rate of return, in this research using the reference cost of capital). If the IRR is greater than the required interest rate / cost of capital, the project is accepted. The calculation of NPV and IRR can be done through the following formula. (Gitman, 2015)

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - CF_0$$

$$IRR = \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t} = CF_0$$

The payback period indicates the period that takes to recoup the invested money with the net cash flow from the investment. Payback Period is intended to measure the time of an investment expenditure can be closed back with the net cash flow generated from investment. If the investment will be assessed using the payback period scoring criteria, the maximum payback period or payback target will be firstly set as a comparison with the payback period of the investment to be executed. Sensitivity analysis has the purpose to overcome the uncertainty in this investment project by identifying the variable that influence the investment value the most when it changed. The result of these analysis will be used to define recommendation for related stakeholder to take attention to maintain the feasibility of the project under uncertain condition.

RESEARCH METHODS

This research uses both primary and secondary data. Primary data is acquired from author sources such as initial investment required, cash outflow projection. Secondary data was collected from reports, books, journal, article, and website. Secondary data, both qualitative and quantitative information are used as input for financial analysis to produce financial projection, capital budgeting and sensitivity analysis.

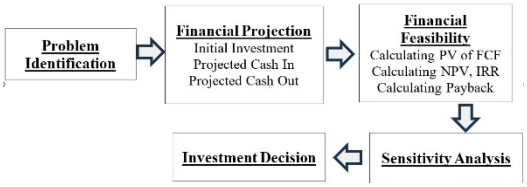

Figure 2. Research Methodology

Figure 2 shows research methodology of this paper that start with problem identification of the project. After that based on primary and secondary data author defined required initial investment, projected cash in, projected cash out , define the financial assumption (described in Table 1) and generate projected free cash flow to the firm (FCF). Then financial feasibility is carried out using capital budgeting method using financial assumption in Table 2, to calculate present value of free cash flow, to calculate net present value (NPV), internal rate of return (IRR) and calculate payback period. Lastly, Sensitivity analysis is conducted to observe the most influenced variable among set of variables of investment project. The variables consist of initial investment, operational expenditure, sales volume, selling price, and interest rate. Two modifications carried out at these variables which are swinging the value by 20% lower and modifying the value by 20% higher. The sensitivity result of modification will be presented in the Tornado Chart to see the impact of variable modification to the NPV of the medical implant investment project.

Table 2. Base of Financial Model Assumption

Description	Value	Sources
Income Tax Rate	22%	UU no 7 Year 2021
Exchange Rate (Rp /USS)	4.870	Bank Indonesia on 2022
10 Years Interest Rate (SUN)	6.36%	PHEI July 2023
Long Term Interest Rate	10.40 %	Primary Data
Source of fund	-	60% Loan, 40% Equity
Risk Free Rate	4,32%	Calculated
Market Risk Premium (Rm-Rf)	3,57%	Calculated
Beta	0,81%	Calculated
WACC	7,75%	Calculated
Annual Salary Increment	5%	Primary Data
Annual Production Capacity	13.433 Set	Primary Data
Annual working days	240 Day	Primary Data

Investment project decision will be decided based on result of capital budgeting parameter in comparison with the target results.

RESULTS

4.1 Free Cash Flow

Free cash flow is a metric that represent the amount of cash flow from operations that available for distribution after the company has covered its operating expenses, taxes, CAPEX, before interest payments to debt holders. Calculation of free cash flow to the firm of this project is described in Figure 3. Company is projected to start generating positive free cash flow USD 154.289 on 2nd years of the project and positive cumulative free cash flow USD 609.289 on 4th years of the project

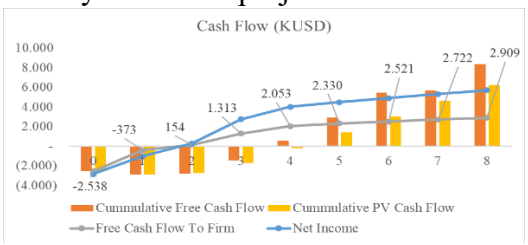

Figure 3 Cash Flow Illustration (Source: Author' Analysis)

4.2 Capital Budgeting Analysis

4.2.1 NPV

Table 3 Capital Budgeting Result

Initial Investment	(2.250.574)
WACC / Discount Rate	7,75%
Total PV Cash Inflow	8.503.227
Net Present Value (NPV)	6.252.653
IRR	35%
Payback Period	3,7
Discounted Payback Period	4,1
Profitability Index	3,8

Net present value can be calculated by summing present value of each of the cash flow with discounted rate 7,75%. Based on Table 3, we found that NPV of this project is USD 6.252.653. Since the project has positive NPV or NPV > 0, It means that the sum of the present values of the cash inflow generated by the company exceed the present value of of cash outflow for the investment. So, the project is categorized as good investment and should be accepted based on the NPV perspective.

4.2.2 Internal Rate of Return (IRR)

Calculated Internal rate of return (IRR) of this project is 35%. It indicates that the project will have NPV = 0 with discount rate 35%. Since the IRR is bigger than weighted average cost of capital (WACC 7.75%) so the project is accepted based on IRR criteria.

4.2.3 Payback Period and Discounted Payback Period

In term of payback period, we can see from the calculation and graphic extrapolation that the payback period and discounted payback period is 3,7 years and 4,1 Years respectively. The company will get payback from its investment 3,7 years after the investment and 4,1 years after the investment based on discounted payback period. Since the project period is 8 years, so the company will receive back the invested money before the project completion and it is accepted.

4.2.4 Profitability Index (PI)

Profitability Index (PI) measure the rate of feasible investment base on ratio between net present value of cash inflow and initial investment as cash outflow. This project has present value cash inflow USD 8.503.227 with initial investment USD 2.250.574. The profitability index for this project is 3.8. So based on profitability index, the project is accepted. This metric provides a figure where every dollar company invested, the firm will get NPV return 3.8 times.

4.3 NPV Sensitivity Analysis

At this case, authors exercise the NPV sensitivity based on the changes of input ± 20% of several variable such as selling price, sales quantity, interest rate, OPEX, Initial investment, material cost and debt financing ratio. NPV sensitivity changes to those variables is described in Figure 4.

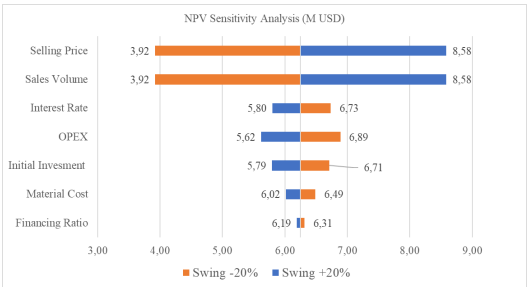

Figure 4 Tornado Chart NPV Sensitivity
(Source: Author' Analysis)

Variable that gives increment of the NPV when its number swing +20% increase to the base is selling price and sales volume. Meanwhile the remaining selected variables such as interest rate, OPEX, Initial investment, material cost and debt financing ratio will give reduction to NPV when the its value swing into + 20% increase. When those variables swing into -20%, the NPV behavior will be the opposite of swing +20%. Based on the tornado chart, critical variable that change the NPV into more than 30% shifting is sales volume and selling price where increase 20% of sales volume in each period will dramatically increase the NPV into USD 8,58 million meanwhile reduction of sales volume will reduce the NPV into USD 3,92 million. The same result behavior or result also occur at the selling price, where the change of selling price will change the NPV ± 37% from the base NPV.

Overall, this sensitivity analysis reveals that this project exhibits a relatively low susceptibility to uncertainty in its variable input where NPV is still > 0 or in acceptable value when subjected to variables change. The maximum observed variation in NPV is at ± 37% from the normal calculation when it is subjected to alterations in sales quantity or change in selling price with, swinging at range +20% to -20% from base variable assumption.

CONCLUSION

Based on result and analysis, the project is feasible and accepted. Based on calculation of discounted cash flow method give a net present value (NPV) USD 6.252.653, an internal rate of return (IRR) 35%, profitability index 3.8 and payback period 3,7 years. Furthermore, sensitivity analysis reveals that this project exhibits a relatively low susceptibility to uncertainty in its variable input where NPV is still > 0 and in acceptable value criteria when subjected to variable changes. The maximum observed variation in NPV is when the sales quantity variable alters to -20% from the base variable assumption that resulted at NPV drop 37% to USD 3,92 Million. Selling price variable also exhibit the biggest impact to the NPV result at this project, where the reduction of selling price variable around -20% will result to NPV around 37% to USD 3.,92 million.

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