

A Goal Programming Approach for Evaluation of Design Alternatives of End-Of-Life Products under Stochastic Yields in Multiple Periods

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ABSTRACT

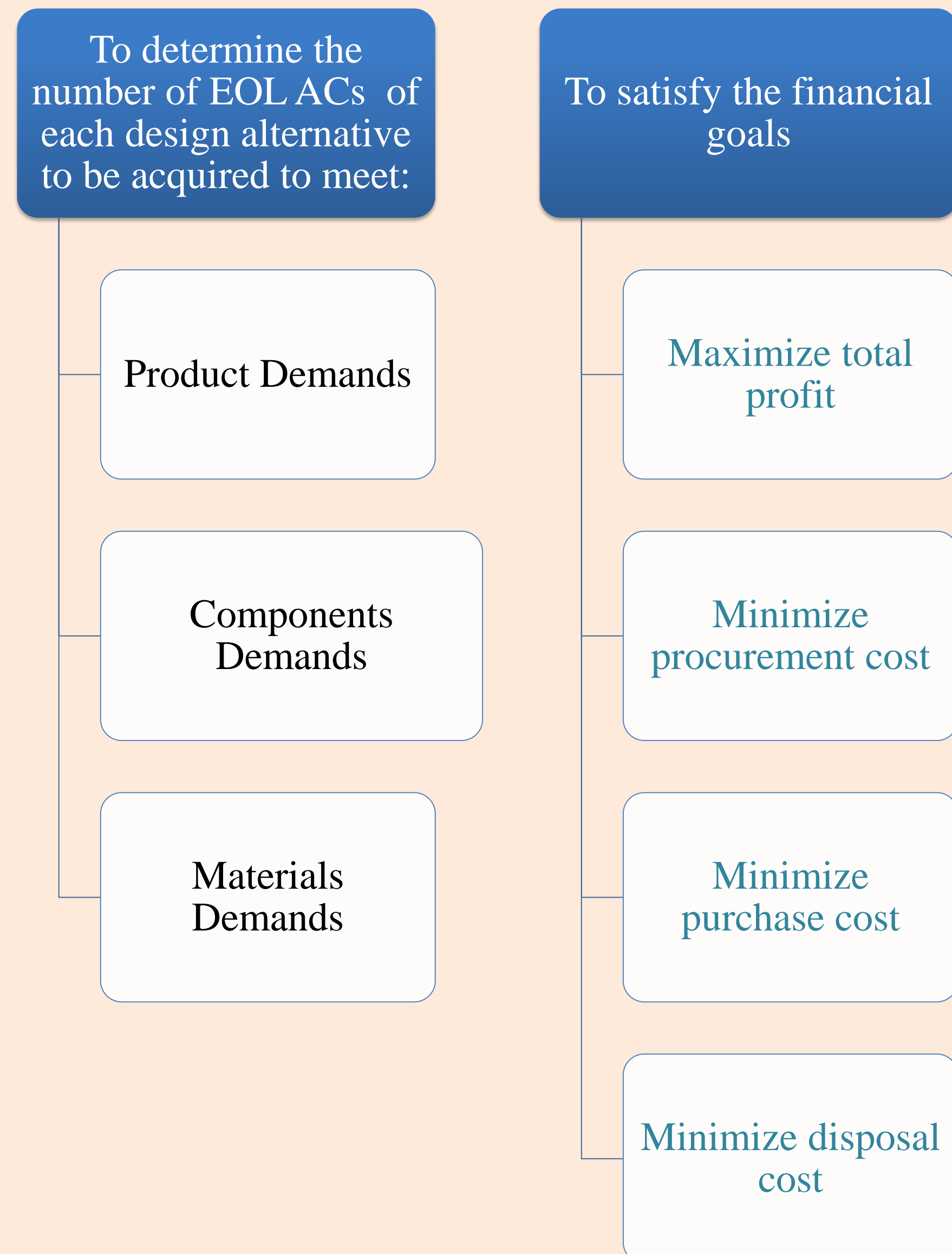
- Advanced-Remanufacturing-To-Order-Disassembly-To-Order (ARTODTO) system acquires EOL products in order to meet the products, components and materials demands.
- EOL products are acquired from different suppliers which provide different design alternatives of the product.
- A goal programming approach is considered to formulate and solve this multi-criteria ARTODTO system in multiple periods.

INTRODUCTION

- There has been a tremendous increase in the number of disposed products due to the :
 - Technological advancements
 - Variety of consumer products
 - Affordability of consumer products
- Original Equipment Manufacturers (OEMs) are implementing product recovery techniques in order to:
 - Prevent the hazardous effects of the product disposal on the environment
 - Comply with the government rules and regulations
 - Earn profits



OBJECTIVES



RESULTS

Aspiration levels and goal values

Goals	Aspiration Level	Step 1	Step 2	Step 3	Step 4
Total profit (\$)	30000	31954.21	30000	30000	30000
Procurement cost (\$)	8500	8328.47	7881.25	8500	8500
Purchase cost(\$)	35000	36654.47	35175.28	31994.68	35000
Disposal cost(\$)	2000	2483.78	2327.59	2289.16	2197.11

Number of purchased EOL products

Purchased products for design alternative 1	316
Purchased products for design alternative 2	131
Purchased products for design alternatives 3	270
Purchased products for design alternatives 4	250
Purchased products for design alternatives 5	313

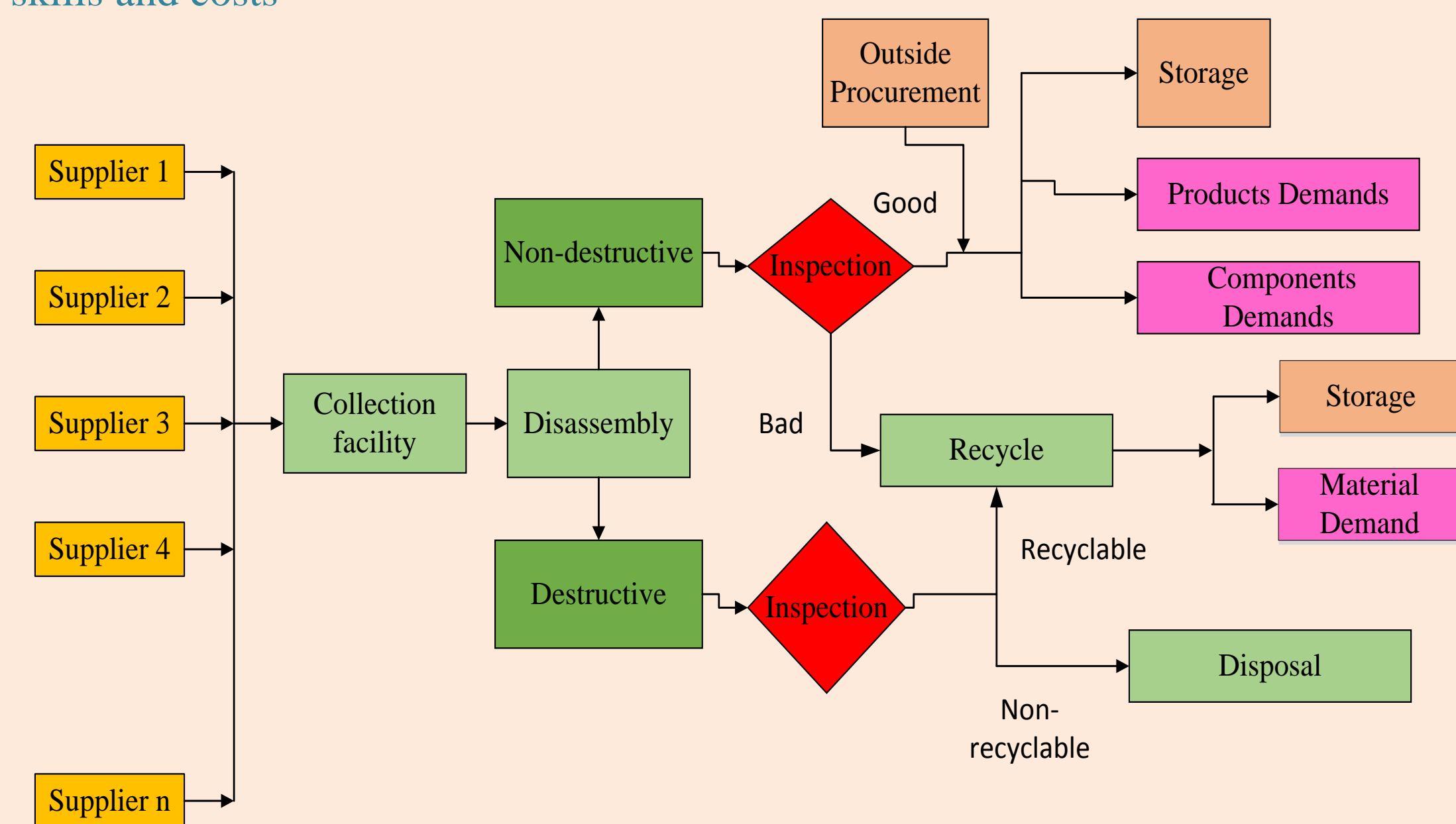
Similar calculations are performed to determine the goal values and number of purchased EOL products for Period 2 and Period 3.

References

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SYSTEM DESCRIPTION

- The received EOL products are available in various design alternatives depending on customer's demands, manufacture, model, version, use etc.
- Evaluation of these design alternatives becomes crucial for selecting the best possible choice for a customer.
- The various factors that may differ depending on the design alternatives are:
 - Size
 - Location of use
 - Ease of disassembly
 - Time for disassembly
 - Labor skills and costs

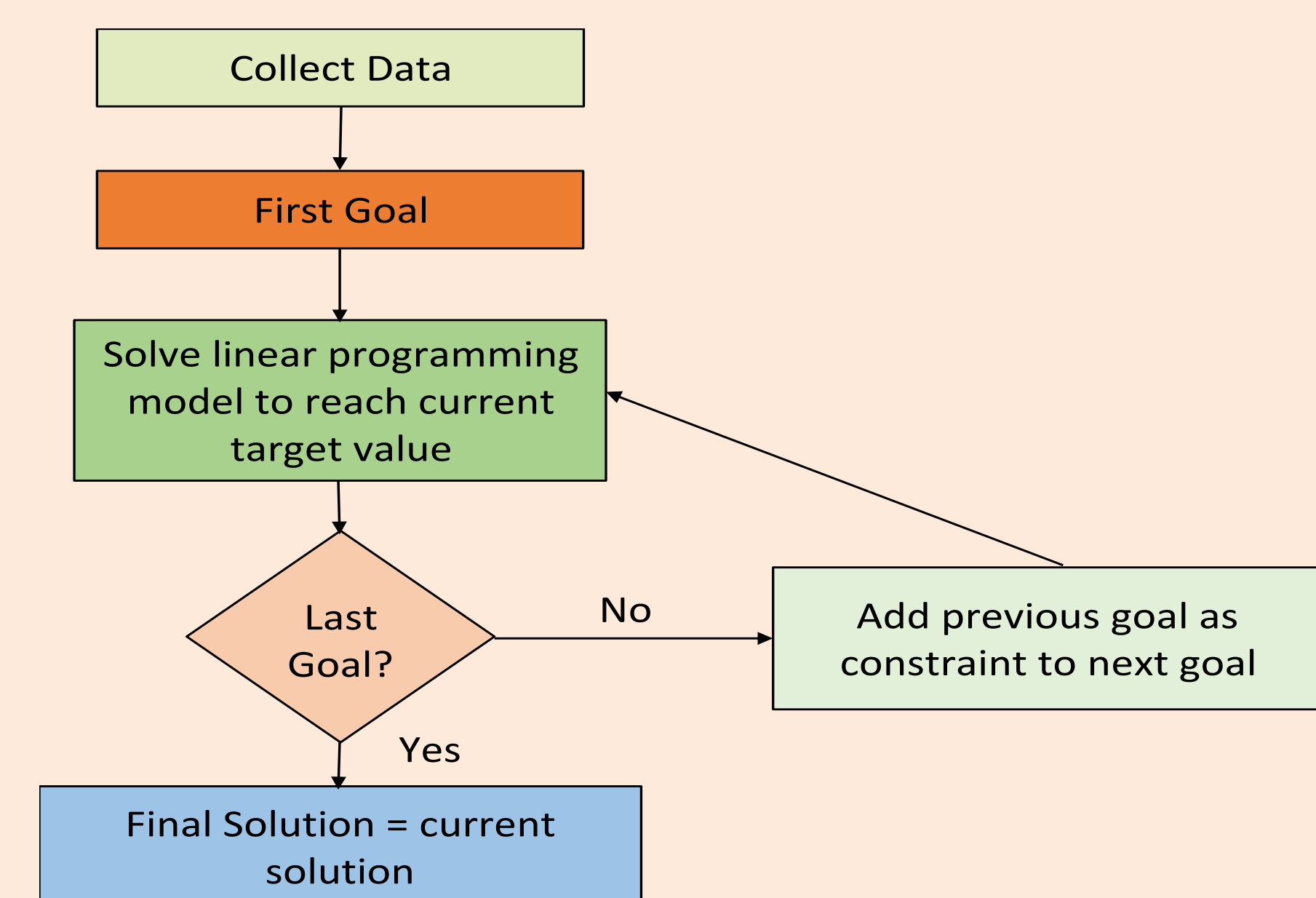


HEURISTIC METHODS

- The conditions of the received EOL products are unknown which makes the problem stochastic. Heuristic methods are used to:
 - Overcome the uncertainties related to the unknown conditions of the received EOL products by estimate the probability of yield
 - Convert the stochastic yields to their deterministic equivalents
- If the actual yield is lower than prediction, outside procurement cost increases.
- If the actual yield is higher than prediction, storage or disposal cost increases.

PROBLEM FORMULATION

- The ARTODTO problem is a multi-criteria decision making problem and is solved using goal programming.
- In goal programming, various criteria are referred as goals and each goal has a pre-set aspiration or target level.
- Goal programming satisfies these several goals while restricting resources by constraints. The goals in the order of their priorities and constraints for this problem are given next.



CONCLUSION

- In this paper a multi-criteria Advanced-Remanufacturing-To-Order-Disassembly-To-Order system was proposed to:
 - Optimize the purchase of ACs from suppliers while achieving the desired levels of multiple criteria
 - Meet the varying demands of components, products and materials in different periods
- Design alternatives can be evaluated using this methodology to determine the best design for the ease of disassembly and remanufacturing.