Project – Part II

ESTIMATING THE AGV REQUIREMENTS FOR A HYPOTHETICAL FLEXIBLE MANUFACTURING SYSTEM

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Due date: December 18, Thursday 23:59

1. AIM AND DIRECTIONS

Automated Guided Vehicles (AGVs) are driverless vehicles programmed to transport materials within a facility as in Figure 1. They have been around since the 1980s, but the vehicles that followed wires, paints, or magnetic tapes on the floor in those earlier applications, have now been replaced by mobile robots with autonomous navigation, smart sensors, and wireless communication features. Applications in the Turkish industry are much more recent but have gained considerable acceleration during the past couple of years.

Figure 1: An unloaded AGV on its path

The design of an AGV system is a complex problem that involves many interdependent design aspects such as AGV flow path layout, AGV fleet size, transfer lot sizes, buffer sizes, and the set of operational control policies. The main aim of this assignment is to introduce the student to some of these aspects for developing an understanding for the use of AGVs for material handling operations. The assignment has already given some of the concepts regarding the flow path and pick-up/delivery nodes. The current assignment will focus on estimating the number of AGVs required to accomplish the WIP movement on a given layout, in this case, the layout that you constructed in the assignment. As the analyst, you are expected to calculate the number of AGVs required to run the facility smoothly, and then present and discuss your results in a report.

2. PROBLEM DEFINITION

Consider the manufacturing environment described in Part I. All part transfers among workstations as well as to and from shipping and receiving departments will be carried out by a fleet of automated guided vehicles (AGVs). Based on the machine layout that you have designed for that facility, now you need to decide on the number AGVs in the fleet.

The selected AGV type can carry one unit load (i.e. one part) at a time. It is possible to load or unload the AGV from both sides. AGVs align at the delivery (D) nodes of the workstations to unload a unit load and at pick-up (P) nodes to get a unit load. Pick-up and delivery times include alignment and communication times as well as loading and unloading times. AGV battery lasts around 8 hours and

each AGV is expected to need a recharge once within the 16-hour working period. Recharging takes around 1 hr. The properties of your AGVs are summarized in Table 1.

Table 1: AGV specifications

Daily Availability	16 hours per day
Efficiency	85%
Speed	20 m/min
Battery operation	1 hr recharging /16 hrs
Pickup Time	0.5 minute
Delivery Time	0.5 minute

AGVs will travel forward only along one-directional aisles and they will always be routed along the shortest path to their destination. Vehicle collisions are avoided through zone control or central control by permitting only one vehicle in each lane or node at a time. Furthermore, it is assumed that sensors or cameras on vehicles can keep them from running into obstacles. Thus, you can assume that the facility can operate with any number of vehicles without accidents.

2.1. Tasks

The basic tasks are highlighted below to provide you a guideline. In this paper, Egbelu [1] discusses the challenges related to AGV fleet size estimation and examines the performances of some analytical methods that he proposes for this purpose. You will use this paper as the basis of your analysis, so read it carefully.

A. Discussion about the pros/cons of AGV usage:

State the potential benefits or drawbacks of using AGVs instead of manual material handling devices (i.e. handcarts, forklifts). You are strongly encouraged to examine some appropriate additional resources. **Properly refer to each in your text and provide a list of them in FORMAL FORMAT** at the end of your report.

B. Calculation of required AGV number:

Egbelu [1] proposes 4 different methods to estimate vehicle requirements. You are expected to understand and outline each method, highlight their basic differences, and then calculate the number of vehicles by using each of them. Since the efficiency is less than 100%, it should be incorporated into all methods as in Method 1.

C. Compare methods and propose the number of vehicles:

You have calculated the required number by using 4 different methods, but you have to make a decision in your report. Decide on the most suitable vehicle number in your facility by comparing the reasoning behind each method, following the analysis in Egbelu's study, and incorporating your own judgement if you need to.

3. DELIVERABLES

3.1. Project Report

0. Information Page

Next to the name, surname, and ID numbers, write the percentage of each group member's contribution to the project and sign it. Unsigned reports will not be accepted. Also, write each member's contributions to the project (i.e. titles, calculations, etc.).

1. Introduction

A brief statement of the problem defined by the case and a brief review of the analysis technique used in its solution. A reader who does not have this assignment description sheet should still understand what you are telling about.

> **Hint:** Try to make it look like a report to be submitted to your manager instead of your teacher. So, avoid referring to Task A, Task B, or "the previous assignment", etc., find another way.

2. Analysis and Solution

The main body of the report where the solution developed is discussed. The analysis procedure from which the design was derived should be logically developed both quantitatively and verbally so that the person reviewing your report will not have difficulty in interpreting various aspects of your design. Include charts, diagrams, drawings, and tables whenever necessary. If there are extensive calculations or computer printouts, which are not directly required to follow your solution but provide supporting details, they may be included in an appendix. But do not forget to refer the reader to the appendix to see these details.

This main body may be divided into subsections to bring an easy-to-follow hierarchy into your report. For example:

…
2.1. Alternative Layout 1
2.2. Alternative Layout 2
2.3. Comparison

or, a similar outline that suits you.

3. Summary, Conclusion, and Further Remarks

A concise description of the actual solution proposed for implementation. A brief discussion about the robustness of this proposed design (i.e. relative to future and/or dynamic changes in the process plans or production volumes, or to your assumptions). Any additional analysis that you may suggest as further study can be added.

4. Appendices (if any)

Should be properly listed, collated, and numbered.

Reminder 1: The outline above is a general guideline. For instance, you should decide where your discussion regarding task A best fits in your report and plan your outline accordingly. Similarly, make sure that you include the layout figure you are working on in an appropriate section of your report.
Reminder 2: Use formal language in passive voice, and avoid colloquial style (avoid "I, you, what was going on," etc.). The report (excluding appendices) is limited to 5 pages type-written in Times New Roman, 12 fonts, and 1.5 spaces. Charts, diagrams, drawings, and tables should have proper

captions, and readable legends and should be referred in the text as shown in this document. You can have sub-sections in your outline. You may use this document as a template for sub-sectioning. USE A SPELL-CHECKER PLEASE, AND CHECK THE STYLE, ENGLISH, AND GRAMMAR OF YOUR REPORT.

Reminder 3: Do not make flow assumptions for the central buffer. Consider the flow of the central buffer as zero.

3.2. Input and Output File

An excel file that contains:
- Flow and distance matrices, and any other data you used.
- Calculations of vehicle numbers by all four methods in separate sheets.
- Any additional work you want to present.

4. GRADING

Content: 70%

Content: Completeness, comprehensiveness, methodology, logical development, and justification of ideas and decisions.

Report format: 30 %

General quality: Format and organization; language, grammar, and spelling; clarity and conciseness including use of charts, graphs and tables, and appendices.

Weight: 40%

5. REFERENCES

[1] Egbelu, P.J. (1987). The use of non-simulation approaches in estimating vehicle requirements in an automated guided vehicle-based transport system. Material Flow, 4, 17-32.