When Does Automation Make Sense?

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What do we mean by automation?

- **Perform certain tasks with minimal human intervention**

- Goal: to improve reliability, increase data volume, reduce manpower and other costs, improve safety, etc.

- Examples from the past:
  - Computer control of telescopes
  - On-site data filtering and normal point production
  - Radar and single operator ranging

Drivers for Automation

- Track more satellites

- More time on target: optimize tracking with respect to schedule, weather, sun

- Unattended operations for 24/7/365 ranging

- Allow reliable operation at remote sites

- Reduce manpower and other long-term costs of operation

- Improve system stability by removing "observer equation"

- Maintain safe operations

Limits to Automation

There are costs in money and time. Where are the trade-offs between short term cost of building or upgrading a station and long term reduction in operating cost and improved volume of data?

1)Costs Tradeoffs

2)Technical Challenges

3)Regulatory and Safety

Limits to Automation: Cost - I

Legacy Station

- Can current infrastructure realistically be upgraded?

- Consider age and adaptability of legacy station, e.g., could a major failure shut down the station permanently?

- How long can station go without taking data, or can changes be made without disruption?

- What automation can be done at the existing station to gain the greatest return on investment?

  – This doesn't need to be full automation

Limits to Automation: Cost - II

- **New station**
  - Is there budget and time to build a new station?
  - These are the elements to consider in terms of cost for each:
    - Design
    - Hardware and software acquisition or development
    - Integration and testing
    - Operational costs, including long term sustaining costs.
  - Can there be collaboration with other stations – ideas, hardware, personnel, etc.

Limits to Automation: Cost - III

- Do steps toward automation need to be done all at once or can they be phased in?
    - Costs of phasing in automation can stretch costs over years.
    - Phasing also helps in learning how to automate effectively, especially regarding software

- Will cost of automation reduce long term maintenance and personnel costs? This is one of the goals!

- Will reducing manpower result in loss of "corporate memory"?

- It may make more sense to automate multiple stations (a network) than just one.

Limits to Automation: Technical Challenges-I

- **Sensors – what are needed for meteorology and metrics?**
  - Mets and sky camera
  - Internal operating temperatures, power levels, etc.

- **MTBF of laser, radar, computers, etc.**

- **Software complexity, edge cases, and adequate testing**
  - How to decide whether or where to range depending on sky conditions, wind, etc.

Limits to Automation:Technical Challenges-II

- Requires data be sent to centralized facility to assess performance and detect degraded performance; this requires more software to be written and personnel to analyze results, which is a technical challenge and raises the cost.

- Sustaining engineering may be more problematic if there are no engineers on site. Must have good remote diagnostics in place.

- Response to safety issues, fire, damaging weather

- IT security, especially for a remote or automated station

Limits to Automation: Regulatory and Safety

- Radar or other aircraft avoidance techniques must be vetted by safety & aviation agencies, which can vary from site to site in the case of international networks

- Ground target ranging risks

- Personnel downsizing issues

Conclusion - I

Full Automation is possible if most of these factors are in place:

- Large (enough) budget

- Resourceful personnel and time are available to find, experiment with, and adapt components and algorithms for the system

- Ability to use other laser stations as a model - would help reduce development time and cost

- Have someone else build it

- Having a network of stations argues for full automation – economy of scale

Conclusion - II

Some Automation is possible in this context:

- Some budget for major renovations

- There are identifiable projects with large return on investment - e.g, pixelized detector, event timer, automation of software

- Can identify the most important outcome – more data, lower costs, etc.

Conclusion - III

No New Automation if a combination of the following is true:

- Little chance of budget to do more than operate
- Legacy system not adaptable to major renovation
- Manpower inexpensive
- No institutional support for expanded mission