

Algorithm Development & Systems Engineering

*A process that improves products while
minimizing risk.*

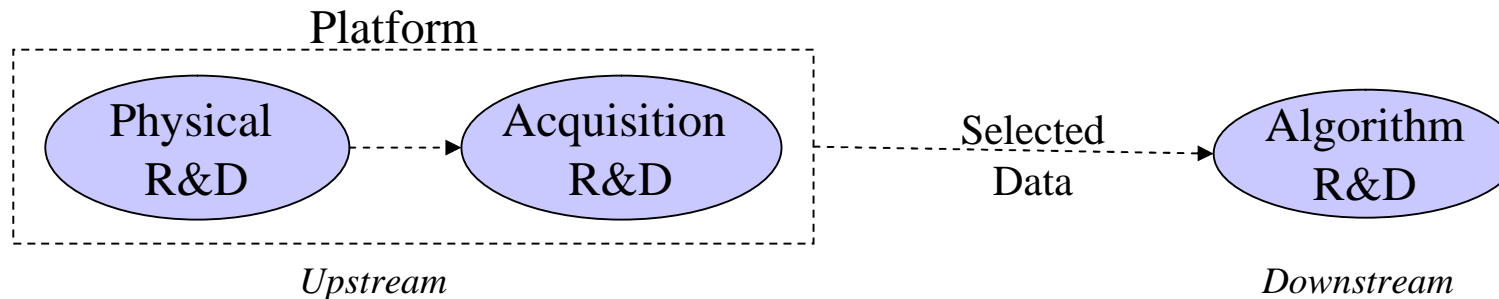
High Level R&D Goals

- Maximize product efficacy.
 - Create the best product possible.
 - Best platform & algorithms.
- Minimize product risk.
 - All components of system well tested throughout the entire development cycle.
 - Management is ALWAYS informed of the current state of the product.

System Engineering Goals

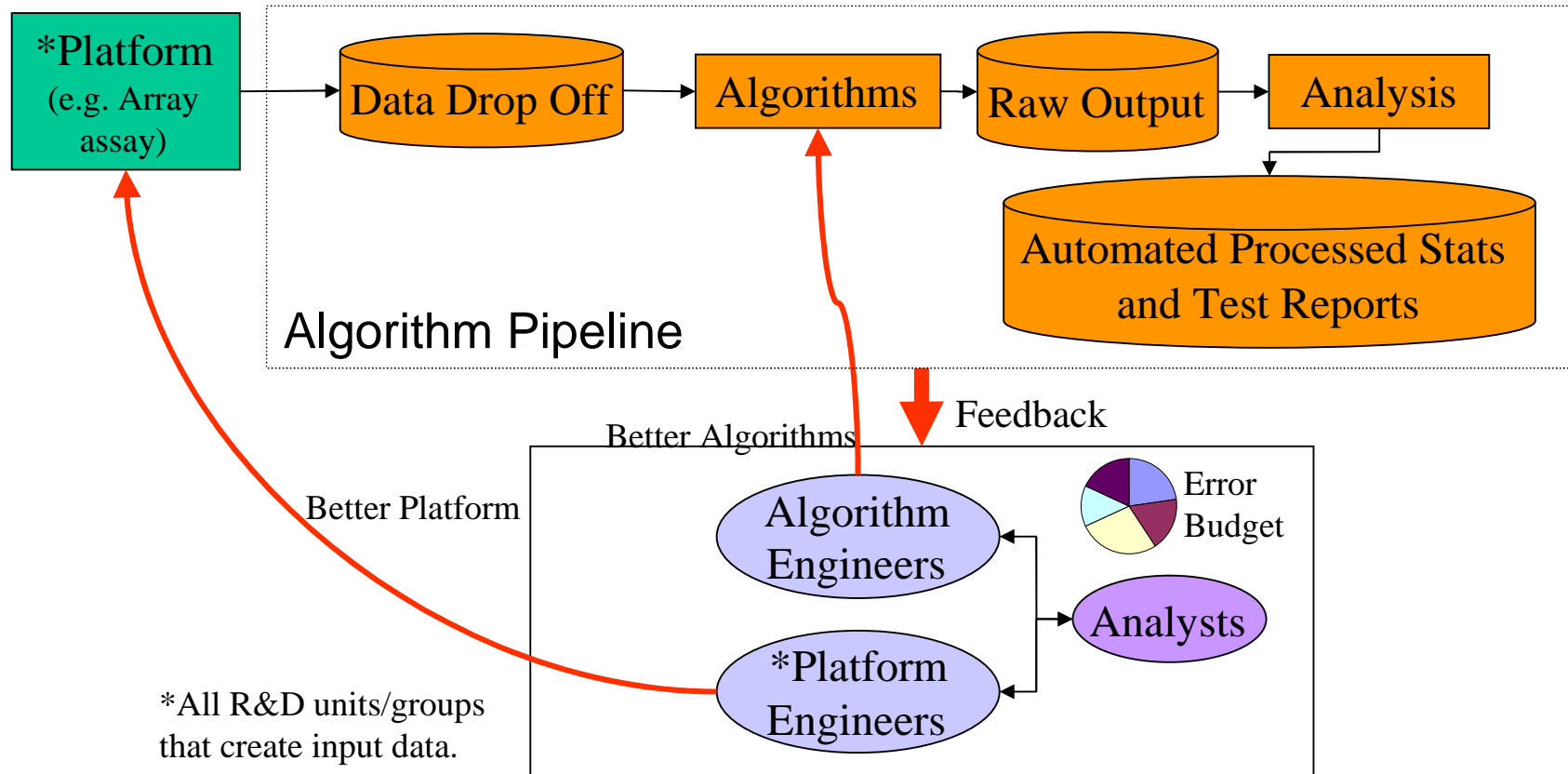
- **Accountability**
 - Process must be able to help pinpoint and fix of sources of error.
- **Rapid development**
 - Automated processing, testing, and analysis of large data sets.
 - Quick iteration \Rightarrow Rapid product improvement.
- **Group Cooperation**
 - Structure development process such that groups feel they are part of a team effort to solve problems rather than escape blame.

Typical Algorithm/System Interaction



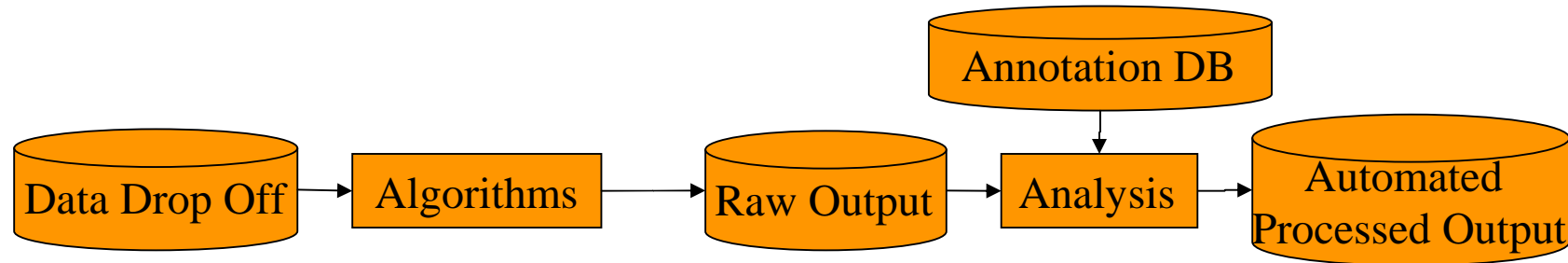
- No systematic approach.
 - Hard to determine error sources and so hard to fix the problems.
- Upstream groups not concerned with downstream groups' needs.
 - Upstream groups get a piecemeal view of the data.
 - Downstream groups don't get proper feedback on the effects of their decisions on the performance of the whole system.
- Algorithms not (consistently/automatically) involved in Platform R&D
 - Algorithms often not brought (fully) into development until end.
 - Implies a lack of automated and large scale quantification of system performance during R&D.
 - Limited experience with representative data limits algorithm performance.
 - Annotation problems plague testing and so slow development.

A System Engineering Approach to Product R&D



- Error budget gives accountability; identifies problem areas.
- Feedback loop provides statistically meaningful quantitative analysis.
- Automated and accurate product performance quantification is the key to rapid product improvement for ALL engineering groups.
- Analysts provide whole-system view and interact with individual engineering groups.

Algorithm Pipeline



- The Algorithm Pipeline provides the automation.
 - Can be run by non-programmers (e.g. scientists, Product Test, etc.)
 - “Algorithms” are the R&D version of the deliverable (product) algorithms.
- Data Drop Off - can be data folders for pipeline to process or a DB.
- Raw Output - can be more than just spec'd product output. It can include desired intermediate results collected during algorithm execution.
- Automated analysis provided by additional non-product algorithms.
 - Combination of desired scripts and previous annotation yields useful statistics.
- Automated Processed Output facilitate rapid product improvement.

