Progress & plans for advanced components

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On behalf of the FSP component team
& FSP management team

Outline

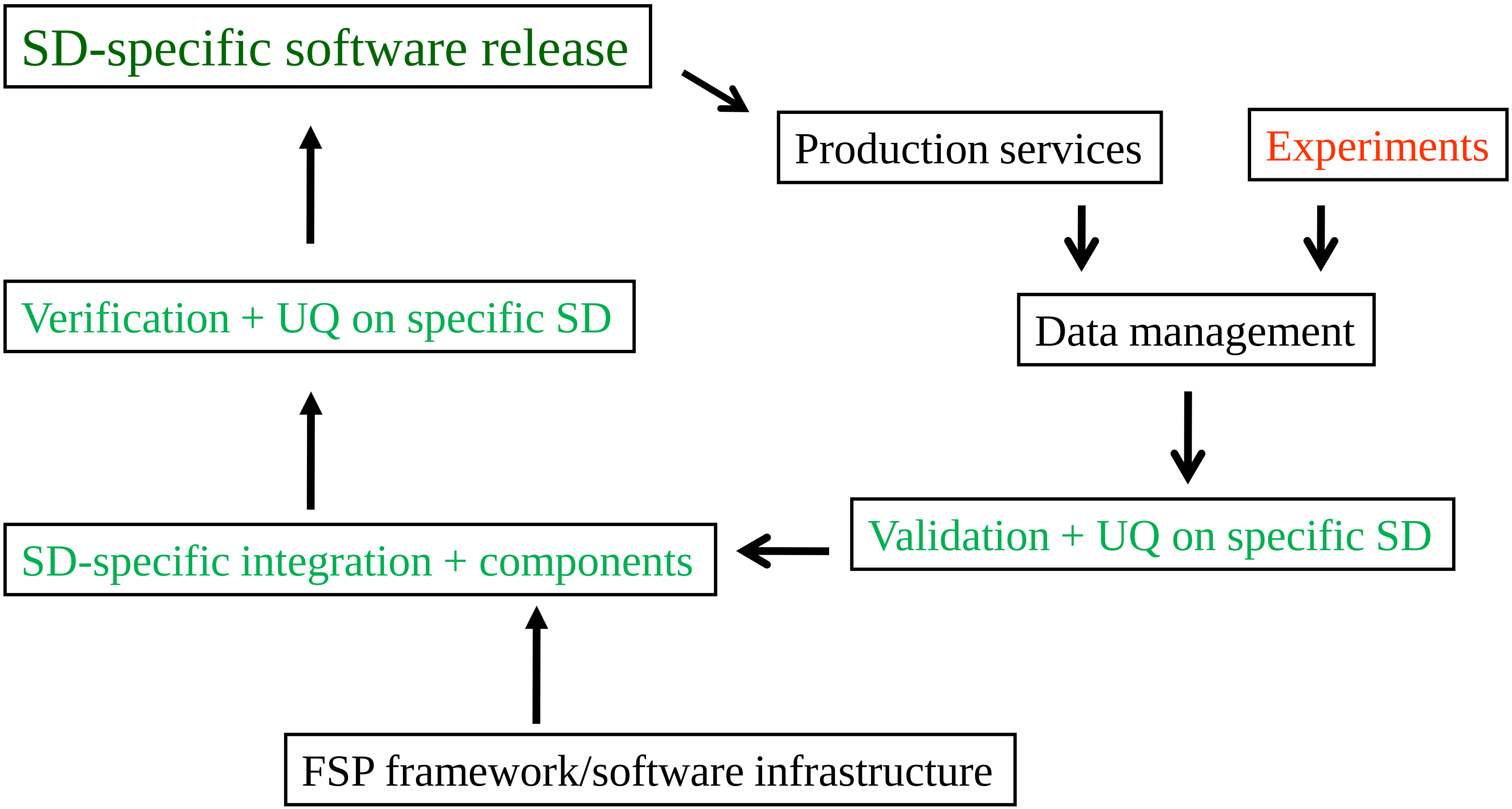
- **PAC charge addressed**
  - **Achieving FSP science goals**
    - **Role and responsibilities of the component team in FSP execution**
      - **Question from previous PAC meetings.**
    - **Prioritization and scheduling in component planning**

➢ **Role of component team in FSP execution**

➢ **Completing the component execution plan**

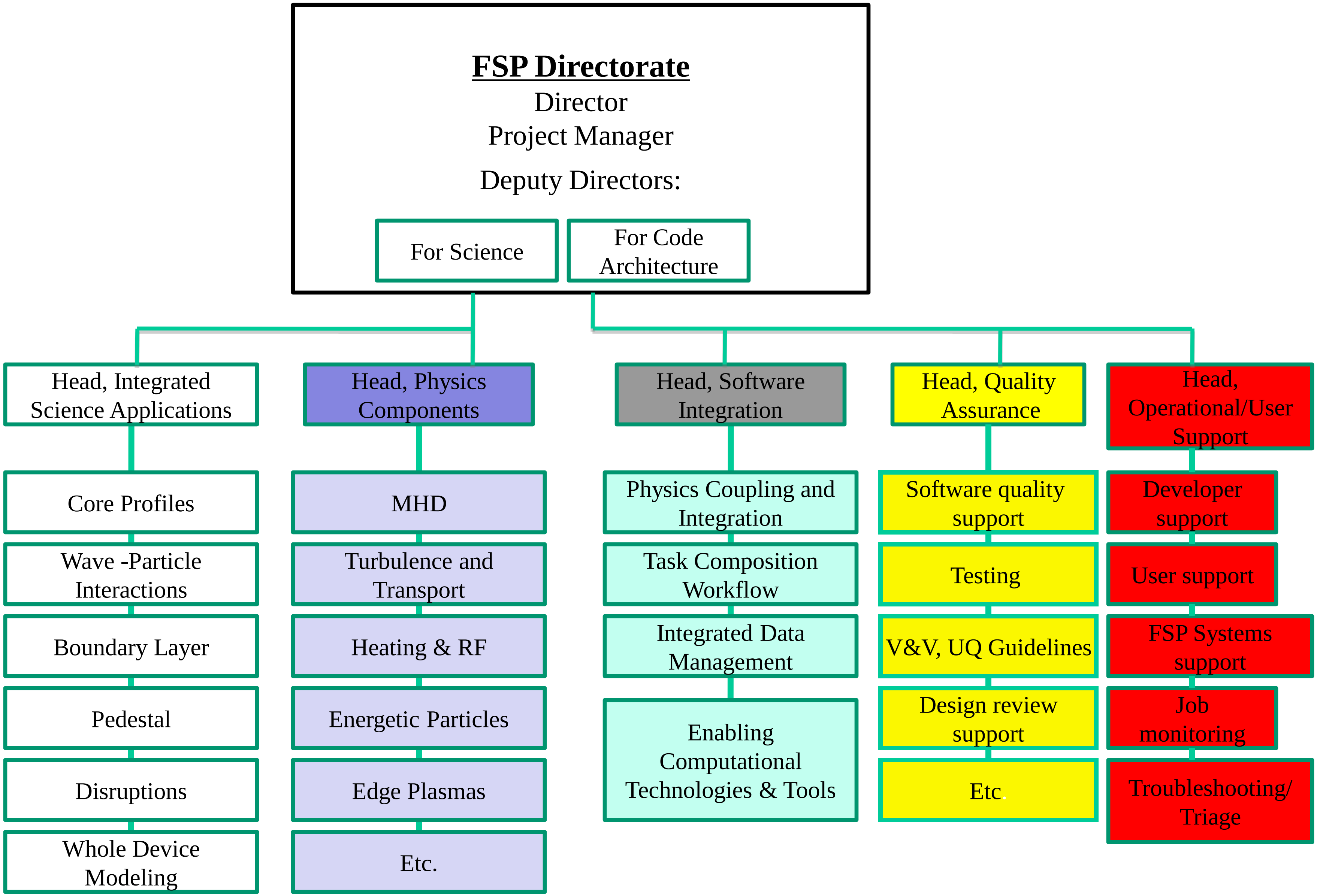
Role and responsibility of component team in FSP execution phase

FSP scope/deliverables are guided by science drivers (SD)



(FSP-PAC presentation 3/2010)

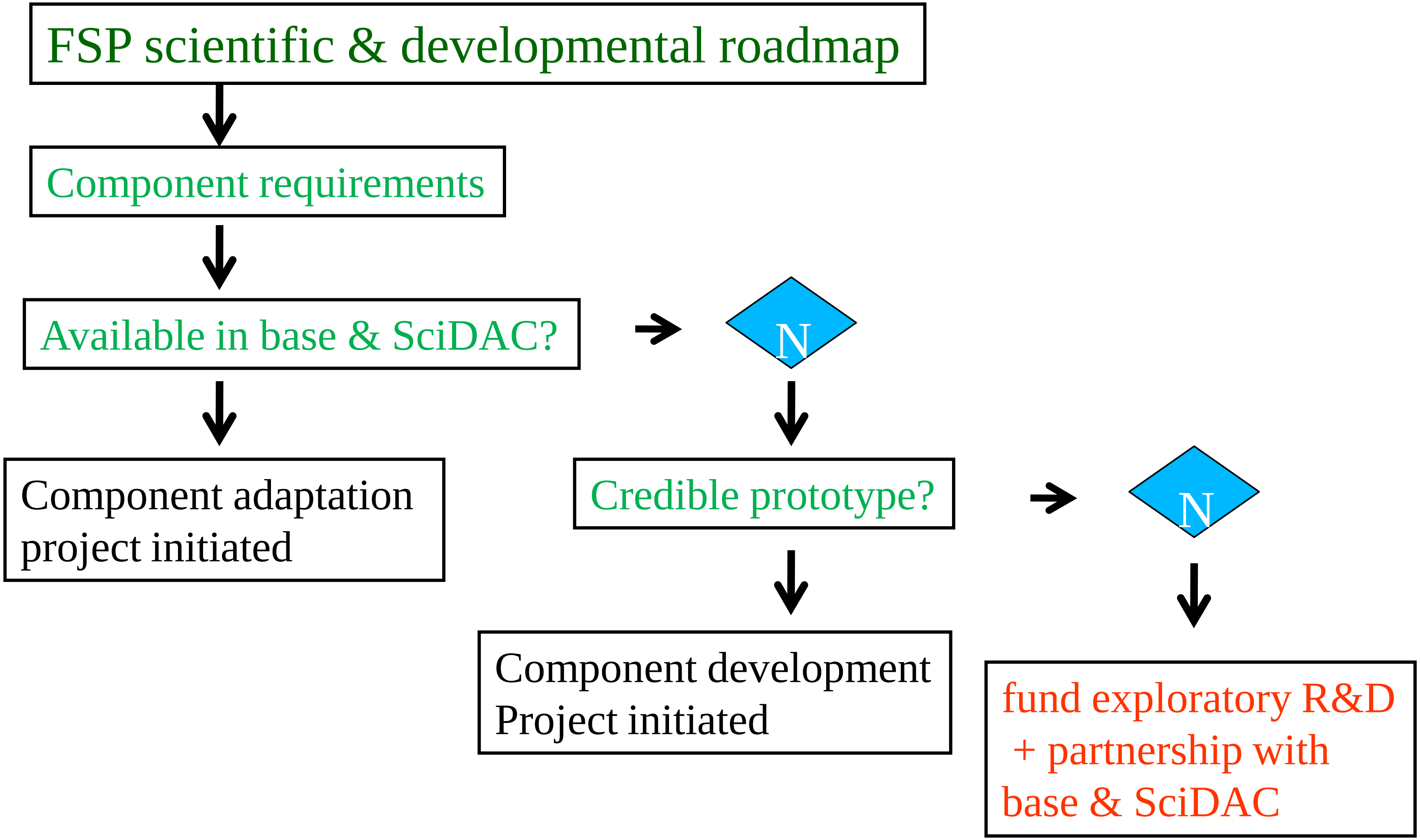
FSP organization tailored to carry out this mission



Role of the component team

- Role of the component team is defined in relation to other parts of FSP, particularly the horizontal science application integration effort:
  - It is a capability organization
    - Holds the technical capability in developing advanced physics components to be integrated into one or multiple science apps to address one or more science drivers.
      - Team has regular and collaborative members.
  - It provides stewardship of the component library
    - Continuously standardize/maintain the suite of physics component codes for FSP science apps.
  - It plans and executes, or manages the execution of,
    - new component adaptation/development projects and the related enabling exploratory research and prototyping.
- **Illustrative examples**
  - It recruits leading subject experts in computational MHD.
  - It maintains a suite of standardized MHD component codes.
  - It initiates and carries out development projects of adapting existing fusion MHD codes into FSP and prototyping new physics models and/or numerical algorithms in response to evolving science driver needs.

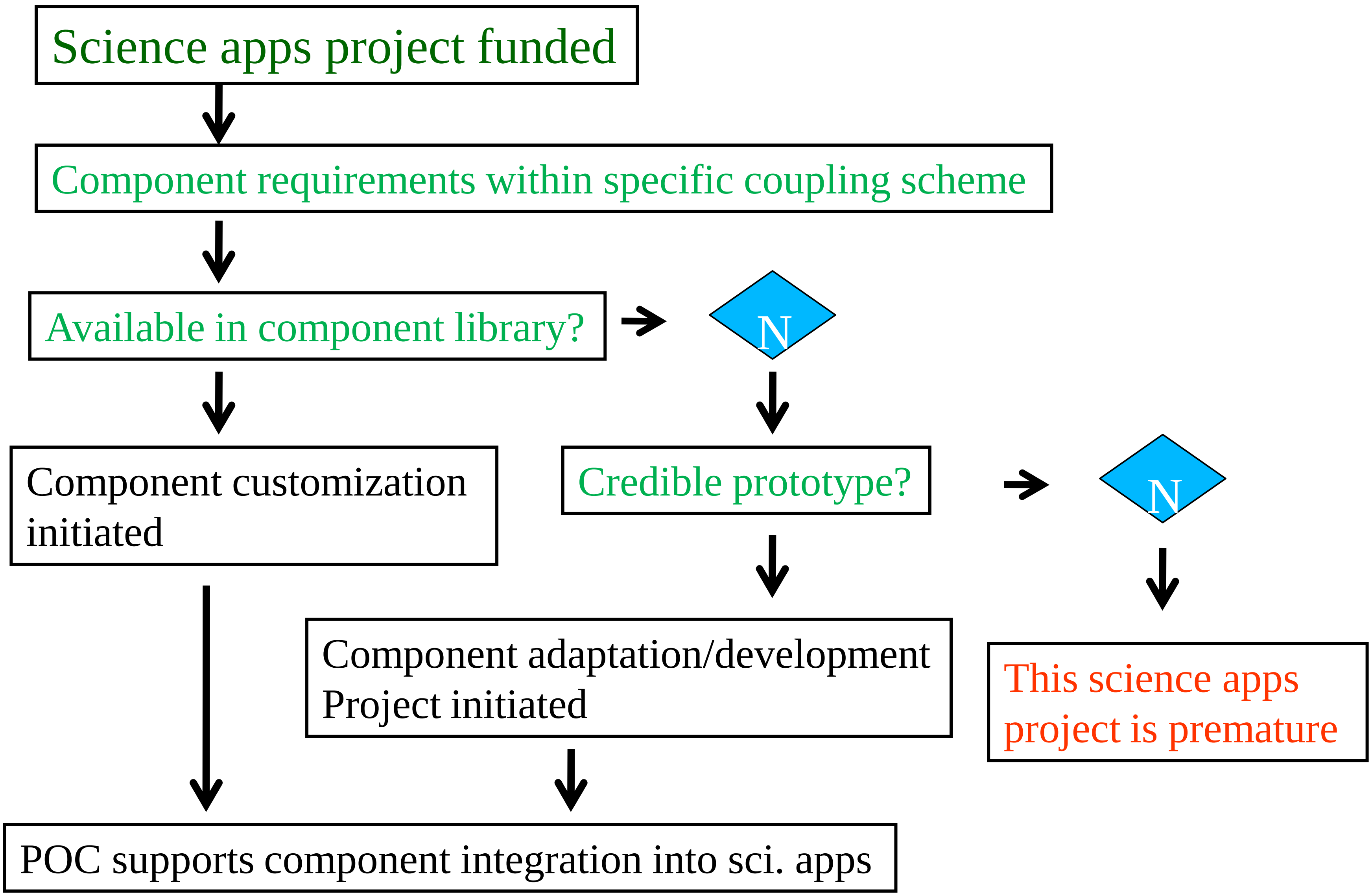
Developing component capability from the FSP roadmap



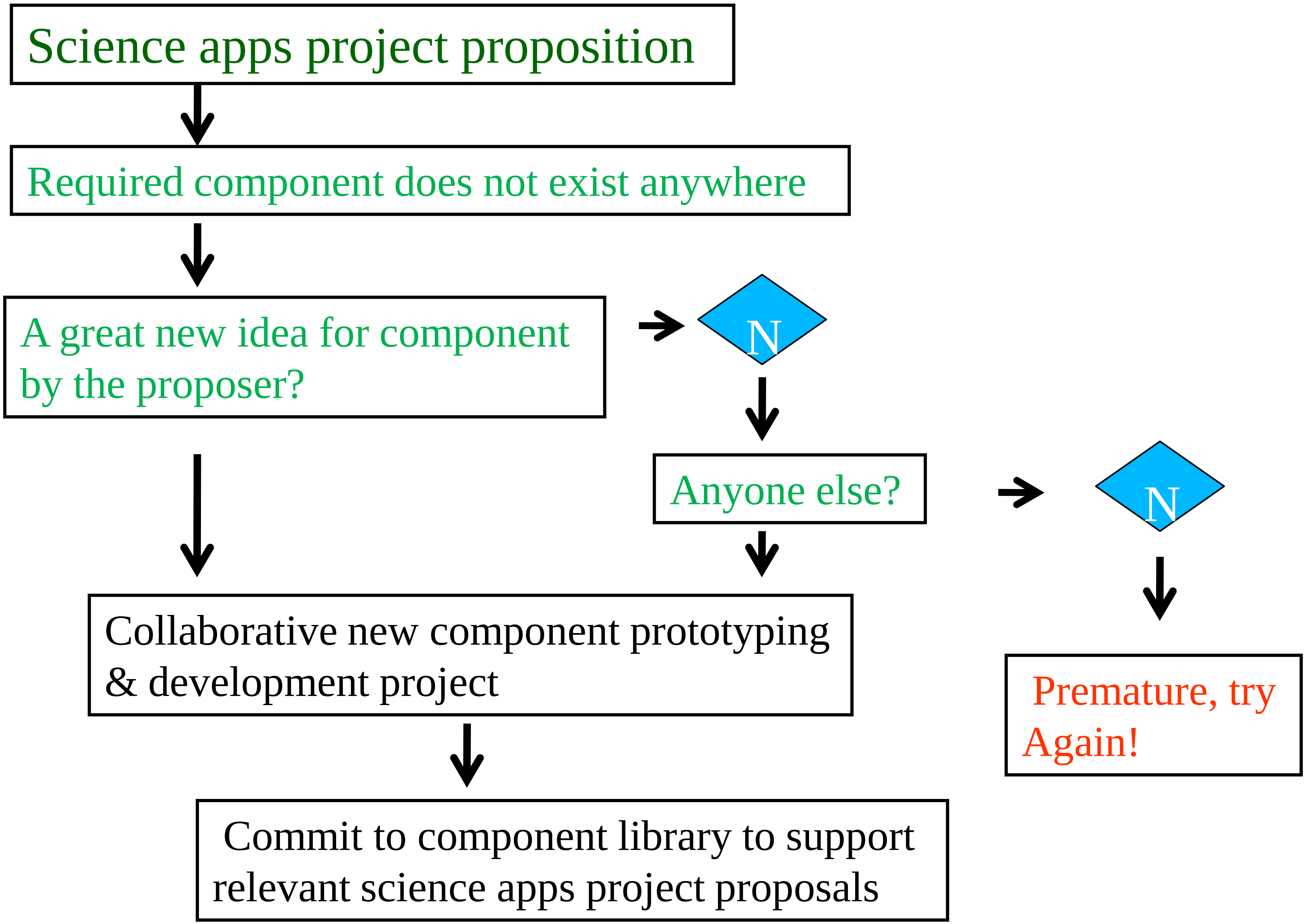
Working with sci. apps team

- From the science drivers, sci. apps lead consults with component team to articulate component functionality requirements. (as done in current FSP planning for the initial set of science drivers)
  - Community is engaged to initiate science apps integration effort in response to the FSP call for white papers.
    - Component team is obliged to interact with the proposers on requirement/feasibility discussions, but only enters collaborative code development for the winning science apps proposers.
    - Science apps proposers can suggest new component development/adaptation.
- Component team gathers component requirements from all ongoing science apps integration effort, coordinating and consolidating the component codes development.
  - **Providing the basis for prioritization and scheduling on a team level.**
- Component team enters an agreement on deliverable schedules (e.g. staged functionality releases) with the science apps integration effort, formally assign component POC's for individual pieces of component deliverables. The POC may or may not be the primary developer of the aforementioned component code.
  - The POC will coordinate the changing requirements and development schedule, and in the latter stage, be the primary support person to ensure the component properly integrated into the science apps.

Supplying components to science apps projects



Developing components for prospective science apps projects

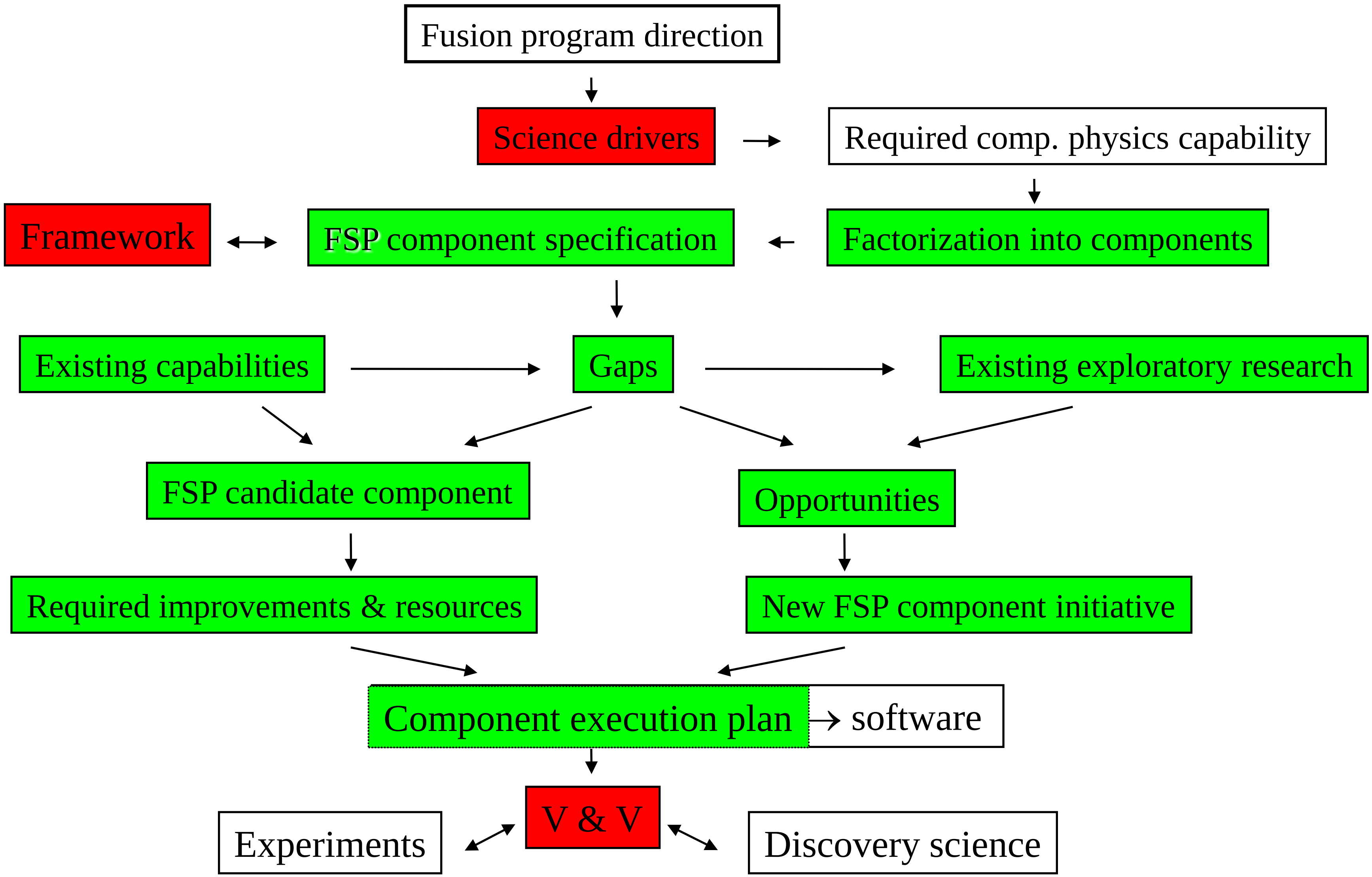


Working with the framework team

- Framework/infrastructure/integration team is a parallel capability organization which provides stewardship of the FSP framework (software infrastructure for integration).
- Work with the framework team to articulate the component functionality requirements in facilitating physics coupling of components.
- Work with the framework team to specify component data communication interface and naming convention.
- Standardizes toward a common FSP (internal) data structure
  - External data representation follows FSP common standard from day one.
- Co-develop and deploy code development technology/standard, best practice in quality assurance, and verification suite.

Completing component execution plan

FSP component strategy being carried out



March workshop report

- **Component factorization + coupling scheme for all six science drivers with near term and long term perspectives**
  - **Pedestal science driver**
  - **Edge-wall science driver**
  - **Disruption science driver**
  - **Wave-particle science driver**
  - **Core profile science driver**
  - **Whole device modeling science driver**
  - **See the March workshop report and the FSP-PAC presentation from 3/2010.**

www.pppl.gov/fsp/documents/Briefings/FSP_PLANWKSHP_REPORT_2010.pdf

Original follow-up plan

- Complete the reports
  - Science challenges
  - Near and long term perspectives by SD
    - Component factorization
    - Component functionality and coupling scheme specification
    - Requirements and gaps
- Complete the analysis/report
  - Across SD's
    - Common components
    - SD-unique components
    - Common physics/integration challenges
- Reach out to broader fusion community for comments & suggestions on the workshop findings.
- Engage OASCR on algorithmic needs and performance issues (with specificity).
- Call for community input to address critical gaps.
- Evaluate community input on ideas/approaches to address critical gaps.

Adjusted path

Alignment with other parts of the FSP planning

- From 4/2010 to 9/2010, fold the component planning into the Integrated Planning Exercise by science drivers
  - March workshop report provides the basis for alignment and refinement.
  - Charge provided with specific tasks in the component area.
  - Component team members are dispersed into the integrated planning teams.
- Rationale:
  - Ensure the component planning and the eventual execution plan is consistent with the overall science driver roadmap.

What's to expect in a few weeks

Charge to the Integrated Planning Teams; reports due 9/30/2010

The primary tasks in the component area, which will be carried out, for both near-term and long-term perspectives, are:

- Translate the science challenges in each science driver into computable integrated physics models.
- Develop a detailed component factorization in the context of specific coupling schemes for the integrated physics model required to resolve each science driver. In cases where applicable, an alternative analysis of the required components and coupling scheme from the Boulder workshop should be carried out.

What's to expect in a few weeks

Charge to the Integrated Planning Teams; reports due 9/30/2010

- Specify the component functionality in terms of the physics model and identify required computational algorithms, and software implementation, along with the functionality of the underlying coupling schemes.
- Specify the requirements/gaps of the primary components and coupling schemes.
- Assess the readiness of existing component candidates and required FSP resources to port them into FSP.
- Assess the feasibility of innovative approaches to address critical component gaps and the required FSP investment.

Example: Component update on disruption SD

Refinement & broaden scope in response to PAC suggestion

- PAC suggested previous disruption too narrow
  - The SD now includes disruption prediction, avoidance, consequences, and mitigation
- SD roadmap & component and component coupling requirements are significantly updated.

- SD specific goals
  - Disruption onset prediction & avoidance
    - Types of disruptions
    - Feedback control
  - Consequence predictions and mitigations
    - Runaway electrons
    - Materials wall
    - Structural forces
    - Active disruption mitigation

Example: Component update on disruption SD

- Component requirements are refined to address the SD goals
  - WDM: 2D plasma states
  - Linear MHD: instability onset
  - 3D equilibrium: model 3D evolution quasi-statically
  - External source: heating and current drive
  - Fokker-Planck: runaway electrons
  - Plasma control: which type of disruption (instability)
    - very different requirements for linear and nonlinear control
  - Extended MHD: this is a large box
  - PMI: a big box in need by other SD’s as well
- Adaptation and new development are identified
  - Advanced kinetic/MHD component
  - Controlling PMI physics for this SD

Action items for the next period

- After the Integrated Planning Reports (10/2010), component team will reconvene to look across the needs from six science drivers and complete the draft component execution plan.
  - Prioritization and scheduling.
  - Gaps and opportunities.
  - Balancing urgency versus importance in execution plan.