RIT Space Exploration Project Design Document Standard Format and Sample Content

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***Abstract*—A standard format for Project Design Documents is key to organize and document the many projects members of RIT Space Exploration wish to pursue. The goal of the SPEX Standard is to organize, refine, and archive space exploration research. Documentation is vital to sharing and maintaining the wealth of ideas and information developed by all students at RIT. Project Design Documents aim to provide a foundation for new projects to grow, or premature projects to develop months or years in the future. A standard for project design documents and reports shall provide SPEX with a robust method to maintain a healthy ecosystem of projects in all stages of development including the event where a SPEX member goes on co-op or graduates.**

Nomenclature

$\dot{m}$	Mass flow rate	$\mathrm{kg\,s^{-1}}$
c	Speed of light	$2.9979 \times 10^8\,\mathrm{m\,s^{-1}}$
PDD	Project Design Document	
RIT	Rochester Institute of Technology	
SPEX	RIT Space Exploration	

I. Introduction

Examples of proper formatting, organizational techniques and content make writing Project Design Documents as easy and painless as possible. Writing documentation such as design documents and reports is a lot of work, but it supports the continued growth of knowledge and experience in science and engineering for SPEX as a whole. In technical research and academia, communicating one's thoughts and ideas is arguably more important than the ideas themselves. For example, when applying to a grant from a scientific foundation, receiving funding to continue research impinges on how the motives and techniques of a research group resonate with the goals and objectives of the foundation.

In the case of SPEX, a PDD carries value in the act of documenting ideas and effectively communicating them with others within and external to RIT Space Exploration.

II. Primary Objective

The SPEX Standard defines format and style guidelines for project documentation. The Project Design Document Standard controls these guidelines as applicable to young, exploratory ideas.

The ultimate goal of a PDD is to capture all ideas (including ones that are beyond our capability, interesting ideas, or things we just dont have time for, in addition to the ones that we actually work on and develop) and archive them such that if a student goes on coop or graduates, these ideas would not leave with them.

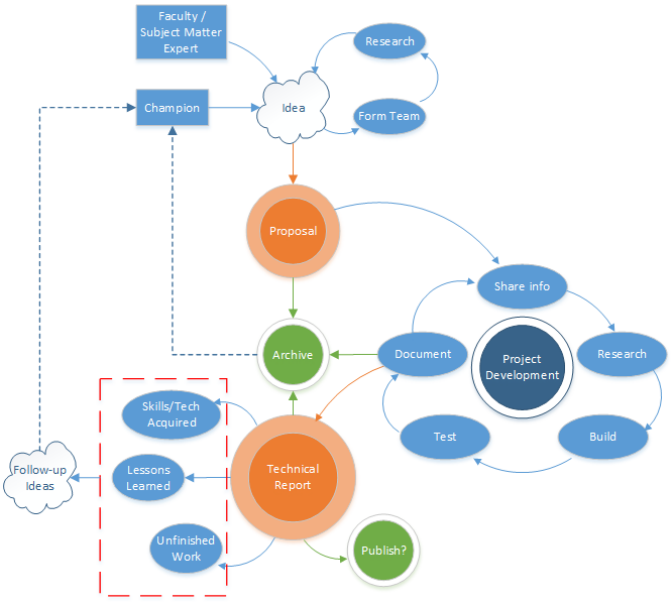

Fig. 1. A PDD is the first piece of documentation to be archived in the project life cycle. Since the life cycle can be iterative, a new design document may also refer to one or more previous SPPs.

Table I lists a the relative level of detail expected of the documents written at each stage of a project's life.

III. Benefit to SPEX

By writing design documents and familiarizing undergraduate and graduate students from any discipline with this type of approach and execution, SPEX members will be better equipped convey their ideas to others in a methodical and organized manner. Ideally, an abundance of ideas and projects encapsulated in PDDs would outlive their respective authors and continue to sustain SPEX with valuable research opportunities invariant of individual members' absences due to co-ops or graduations. Perhaps in the future, SPEX design documents may be used as baselines for grant applications and other funded research efforts.

TABLE I
RELATIVE DETAIL EXPECTED AT EACH STAGE OF PROJECT DEVELOPMENT.

Document	Purpose	Contributors	Destination
Project Definition Document	To define the goals and requirements of a SPEX project.	2–3 people	SPEX Archive
Project Plans	Specific plans for when work is to be done (Gantt charts)	2–3 people	Project Repository
Design Reviews	To review designs before work is started.	6–8 people	Project Repository
Test Procedures	Specific instructions and data logs for tests.	3–4 people	Project Repository
User Manual	Instructions for future users of project deliverabels.	3–4 people	Project Repository
Posters & Presentations	Materials for sharing projects with the public.	5–6 people	Project Repository
Technical Report	Final technical summary of work done and results.	6 or more	SPEX Archive, Conferences & Journals

A. Mindset

Firstly, it gets people in the right mindset for thinking about what is important and what needs to be considered before taking off on a project. Publishing a PDD imbues a sense of formality that hopefully makes its way into the level of seriousness and merit that is desirable for SPEX to pursue.

B. Traceability

Similarly, a PDD serves to provide the foundation for traceability in requirements and objectives to projects as they grow and change. This prevents blockers such as feature creep, rabbit holes, and spun tires, and hopefully prevents good projects from dying by getting too off track.

C. Accessibility

Having a "plug-and-play" template is the first step to learning how to one's own PDD. It removes a major barrier of starting from scratch, providing example content to which one could refer when creating their own. LaTeX may prove to be daunting for some people, but it is arguably better to encourage people to learn LaTeX than to rely on something like Microsoft Word [1].

IV. IMPLEMENTATION

In the ideal case, every project begins with a design document. That design document gets sent around to SPEX members (and non-members) to draw support and build a team. Research and work takes place, documented along the way until an ending point is reached (e.g. project completion, end of the semester, team attrition, etc.).

At the end of the project (or end of semester, whichever comes first), the team writes a report of the project with what they did, if it was successful, and recommendations for future projects. A future SPEX member might pick up where the last paper left off, and the cycle repeats.

A. Deliverables

Physical or intellectual property may constitute a project's deliverables. Test articles, test stands, and other hardware, software, as well as posters, presentations or other reports are all valid deliverables. Not all deliverables may be known at the time of writing a PDD, but at least several key deliverables should be identified at the start of a project. This helps guide the final outcome and is a fundamental part of a project's life cycle.

B. Milestones

Deadlines and milestones provide clear goals from which timelines and schedules may be developed, and also set up a project for a series of "sanity checks" along the project's development cycle. Early on, these milestones include design reviews on system and subsystem levels. Later, milestones are usually important tests or experiments. Events such as ImagineRIT may also serve as milestones to mark a project's development progress or completion.

A notional timeline is shown in Table II.

TABLE II
NOTIONAL TIMELINE OF PROJECT MILESTONES.

Phase	Task	Duration
1	Review existing designs and materials	2 weeks or less
2	Subsystem development	6 weeks
	Order PCB design and/or assembly	6 weeks
	Review changes and order materials	2 weeks or less
	Testing of individual subsystems	2 weeks
3	System assembly	1 week
4	System testing	2 weeks
5	Generate documentation and delivery to SPEX	1 week

V. EXTERNALITIES

A. Prerequisite Skills

It is obvious that team members will learn certain skills as a project progresses, but there are always some tasks that require a minimum skill level to provide meaningful contributions to a project's development. These prerequisite skills are best identified by examining past projects and discussing the project with faculty or subject matter experts. It is strongly recommended to be conservative in skill estimation. Underestimate team member skill levels and overestimate the challenge. Many projects have failed because the team overestimated their own abilities or underestimated the difficulty of their project.

B. Funding Requirements

Like prerequisite skills, it is wise to overestimate the cost of components, materials and other resources that a project requires. For physical projects, costs may be estimated by benchmarking the costs of similar systems or determining a representative bill of materials and using the aggregate cost of its items.

C. Faculty Support

Support from university faculty is almost always essential to a project's success. Faculty provide not only guidance and subject matter expertise, but may also connect a team with resources and networking opportunities. SPEX projects do not require faculty support, but it is highly recommended to identify professors with an interest or expertise in a project as early as possible.

D. Long-Term Vision

As SPEX student members get more experience writing these papers, the group will build a library of meaningful work and be able to save it in an organized manner. Knowledge will be preserved and easily shared. Perhaps Project Design Document could eventually get published, in a journal or otherwise...

ACKNOWLEDGEMENTS

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REFERENCES

[1] L. Lamport, *LaTeX, A Document Preparation System*, 2nd ed. Reading, MA: Addison-Wesley, 1994.

APPENDIX A
PROJECT LIFE CYCLE

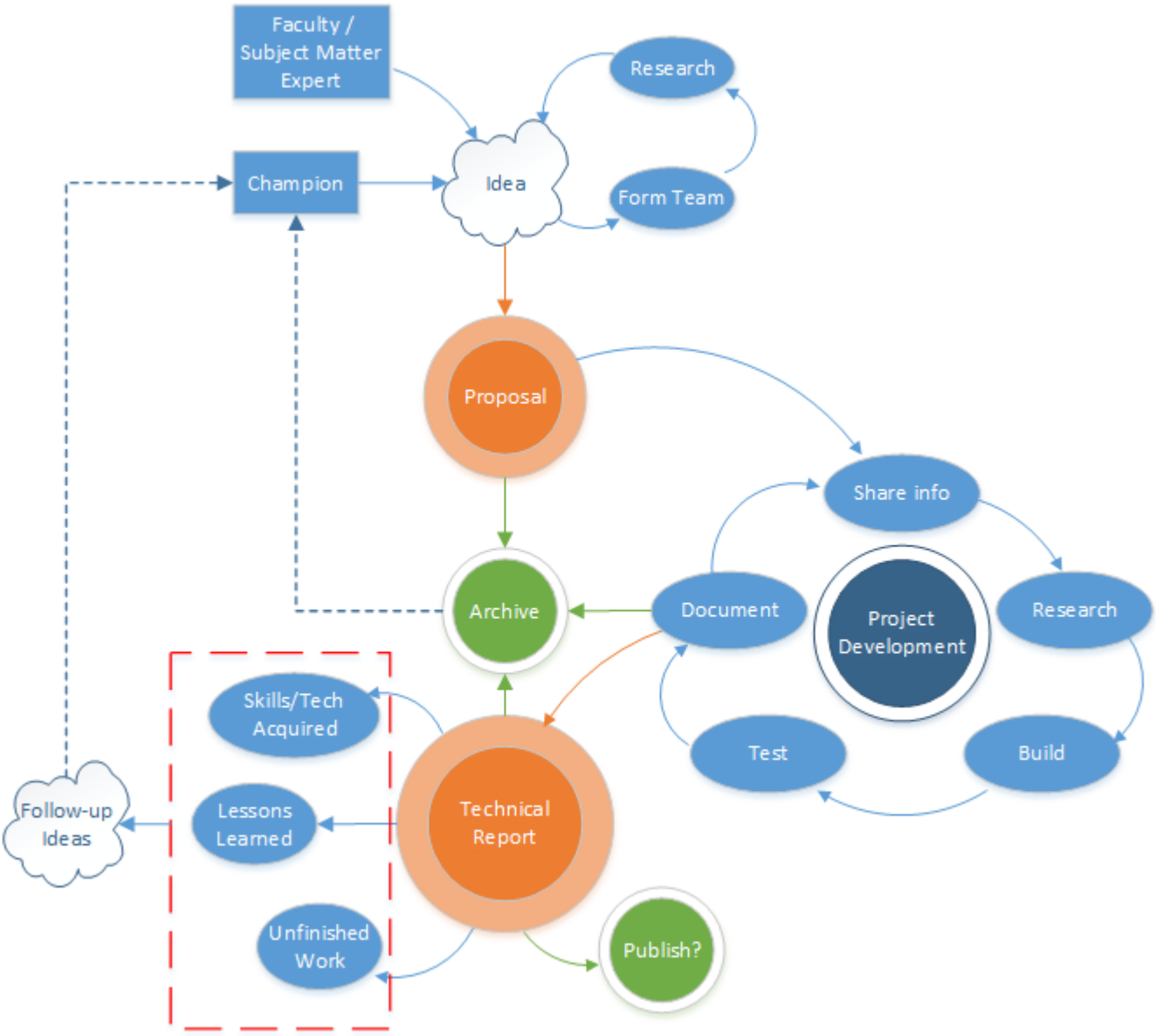

Fig. 2. Enlarged version of the diagram in Figure 1.