

Particle Physics Manager Design Document - Third Draft (24/07/09)

*Numbers in brackets are suggested ideas or example values, names in apostrophes are shorthand or approximate terms for concepts, **key concepts** and terms for the user are bold-ed. [Examples] are given in square brackets.*

Aim

The game is designed to be relevant to GCSE students from a ~1980's/LHC starting point and AS-level students from earlier starting points.

Functionally, the objective of the game is to successfully run a particle physics laboratory over a number of decades. (The terms of that success need to be defined)

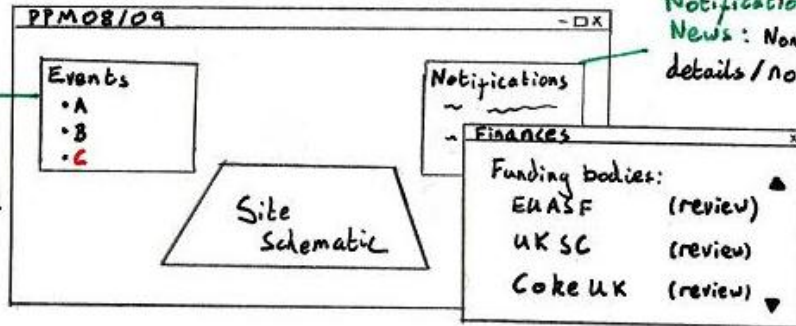
Particular questions for this draft

- Is the finance and resource model appropriate?
- What screen layout is most suitable, both for the main view and each section interface?
- How should the power distribution element of a large-scale physics laboratory be represented mechanically?
- How are staff acquired?
- Which specific projects should be included in the game?
- What random events would be worth including?

Annotated screen layout suggestions

Events:

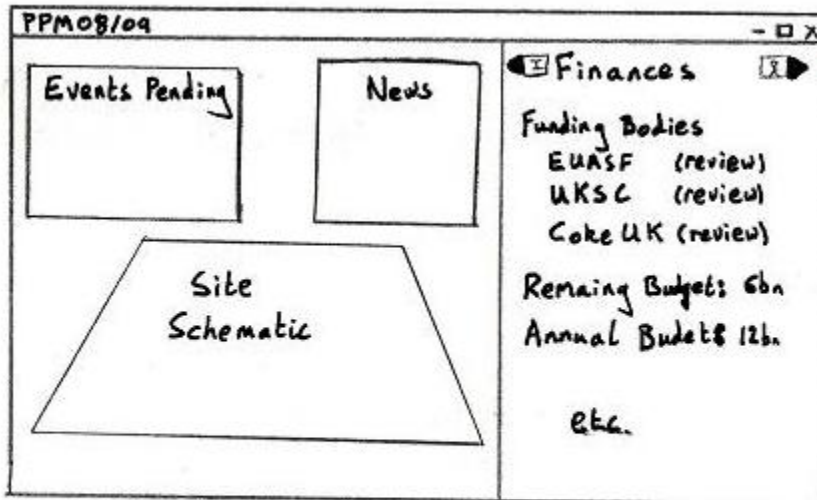
Show user main
current events
requiring attention;
RED until examined



Notification/
News: Non-critical
details / notices

Each area for interaction to use own pop-up dialogue
(Site locations/projects/events)

Layout I

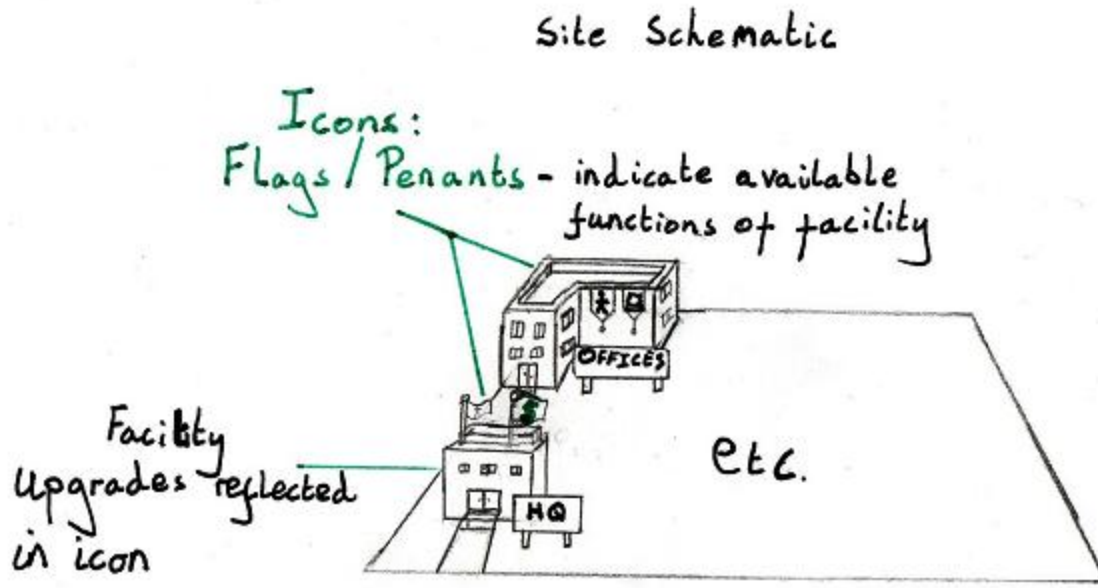


'Sidebar':

used to display
options/information
from site locations,
Can access sections
from schematic,
events or icon-ed
arrows in bar.

'Main' view used by
some sections (eg,
Projects, experiment
design)

Layout II



(For prototype design the location images would obviously be reduced to simple icons displaying name and upgrade 'level')

Projects

Broken into paths of PP research & detector/accelerator development. Each project should have a number of specialist fields weighted by importance (1 primary and 1-2 secondary fields?).

Can be undertaken 'in-house' or 'contracted' to outside groups. Quality of output determined as a function of assigned specialists, workshop facilities and access to accelerator/detector.

In-house:

- Require at least one relevant specialist?
- Lead by resident professor, limited to skills/facilities of the user's site.

Contracted:

- Requires less use of local facilities - office/personnel, workshop, beam time.
- Requires funding from user - may include money, personnel or access to workshop in addition to beam time.
- Allows access to additional specialists and workshop facilities, potentially more suited to a task.

In both cases, additional PhDs may be assigned to a project to speed progress and additional RAs with relevant specialisms can be added to increase 'quality' of output.

PP research advances are more important for earlier start points (and so AS-level students). 'First success' brings a site kudos and Nobel prizes as well as pointing towards future topics for PP and detector research. Success and speed of a given project is heavily tied to type and quality of detector/accelerator.

Detector/accelerator development produces and upgrades the experimental facilities of a site. 'First success' allows for the sale of novel technology created for the project.

The bonuses given for 'first success' could also be applied to projects completed with exceptional quality.

Proposed function for projects: (This function can be relatively complex to include suitable weighting as long as the end result can be communicated simply to a user) [Specialised RAs improve the contribution from all PhDs and RAs assigned; this effect does not have to be linear]

- **Progress** (Reducing the remaining time of a project towards completion)
 - Access to detector - linear contribution of units up to a threshold; requires PhD/RAs.
 - Access to workshop - linear contribution up to a threshold; requires PhD/RAs.
 - PhD/RA grunt work - Minimum number required to access each unit of progress from detector, buffed by relevant RA/Prof and computing facilities. Additional PhDs increase progress (at half rate / at diminishing rate).
 - Thresholds for detector and workshop set main flavour difference between design/construction projects and research projects.
- **Quality** (The value of the end result; indicates precision of a particular measurement or reliability of component. More speculative

projects [looking for new particles/effects] can have their success/failure determined by the quality achieved.)

- Existing facilities - base quality of project determined by combination of existing facilities, weighted by importance to the project in question.
- Specialists - percentage enhancement to quality with specialised RAs/Professors weighted by importance to the project in question.
- Access to detector - percentage enhancement for each unit above threshold.
- Access to workshop - percentage enhancement for each unit above threshold.
- Rate of access enhancements for each project sets main flavour difference.
- Is 'estimated' when setting up each phase of a project; does not increase over time in the manner of progress. This avoids a player being able to reduce investment to a project, slowing it down, to improve it's quality.
- In the final phase (Test/Refine, see below) the project can be continued for a variable period of time to improve quality. In this case, rate of improvement is tied directly to units of 'grunt work' applied and capped (at an additional 50%).
- Projects can be repeated with the quality of the last attempt added to the base quality of the new attempt, allowing an inferior site to spend longer on a difficult task and still eventually succeed.

Project types - all projects are collected under one of the following categories:

- **Theoretical Research**
- **Experimental Research**
- **Site Development**, comprising of the creation of new colliders/detectors and their maintenance. This does not include the upgrades to 'simple' site facilities, such as offices.
- **Communications**, including both outreach and industrial liason

Project Structure

Most **projects** follow the same general structure of 'phases'. At each step,

short explanations of the game and physical effects for each choice should be presented:

- **'Research Direction'** - Presents very general areas for a user to explore. (In-house only)
- **'Proposals'** - Either presents the set of possible routes 'found' by the research Direction phase or else a suggested project from an outside group. The routes are different in flavour rather than quality.
- **'Development'** - The user is shown any options for completing the project. The choices have pros and cons but all ultimately aim to succeed at the objective chosen during the proposal phase. Each should be based upon existing technologies or methodologies for doing that work [silicon tracker vs TPC]
- **'Build'/'Run'** - The bulk of most projects, in which the project is completed.
- **('Test'/'Refine')** - Possible final phase in with no defined end; the user must choose how long to spend confirming results and apparatus before publishing results, etc, based on reports some form of advisor.

Some steps may require existing theory or facilities. This can reinforce the underlying science through a brief explanation of *why* a requirement exists. This also allows the longer projects, such as accelerator/detector design, to be a constant presence for many turns whilst still offering a defined objective to the user.

Some steps may make new projects available at a point beyond the initial phase and infer some amount of interrelation between topics and disciplines.

Suggested **Specialist Fields** - Each project and some staff are assigned 1-3 of the following (should eventually make these simpler titles):

- Theoretical studies
- Accelerator design
- Accelerator R&D
- Experiment design
- Experiment R&D
- Experiment data taking
- Experiment data analysis
- Experiment results publication
- Outreach
- Industrial liaison / knowledge transfer

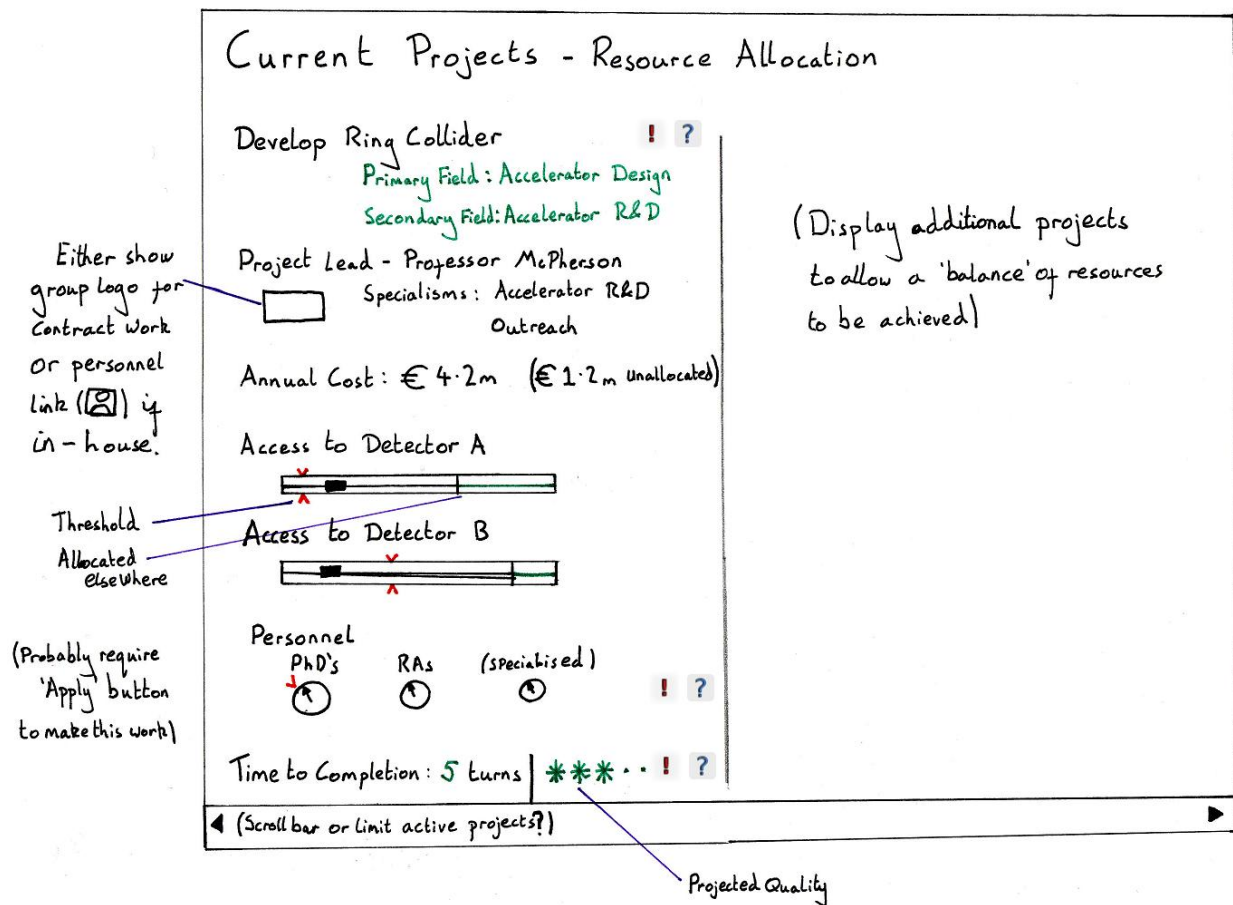
- Infrastructure

Example of Project Structure

Phase	
Research Direction	Upgrade Communications Network (Site)
Proposals	1. Radio network 2. Optical network
Development	For Proposal 2) 1. Analogue modulation (Quicker to implement, more stable at earlier technologies) 2. Digital modulation (Greater capacity, requires more precise components from workshop)
Build/Run	-
(Test/Refine)	Choose how long to spend testing and optimising network

Resource Allocation

At each step the user can decide what resources to allocate to which project. The Resource Allocation screen shows all the projects currently active at the site regardless of type and phase, with icons to communicate the effect of each resource. [For example, the detector access threshold indicates a good allocation for timely completion of a project, as in the proposed function for projects section].



Resources

- Finances (Basic monetary unit: €0.1m)
 - Funding received from (3) '**benefactors**' chosen from a random pool of (8) over an agreed period, to be reassessed every (5) years on the same turn for simplicity.
 - Value of funding given for period dependant on benefactor '**happiness**' at the beginning of the period. Happiness is derived from the benefactors level of involvement in the site (staff, outsourced projects), their stated aims (which gives each benefactor some character), the general popularity of the site, Nobel laureates and similar.
 - If the happiness drops below a certain threshold (10%), rather than further punishing the player with greatly reduced funding the benefactor withdraws and is replaced by another group with

a moderate happiness. Otherwise, the same (3) benefactors continue to be the main source of funding.

- The aims of these funding bodies should form the basis of the user's current objectives. Each body can offer a range of short-term objectives to the player at every reassessment.
- Temporary funding from an additional benefactor can be offered outside of the (5 yearly) cycle as a random event, possibly with more specific requirements. This can be used as either a positive random event or to catch a user that is falling behind on expected progress.
- Can also be generated from 'sale' of technological advances from detector/accelerator advancements.
- Money can purchase additional staff, facilities to house them, improve those facilities and fund the running of projects (via power mechanic?). Note that money cannot directly purchase improvement to a project.

Example finance dialogues:

Budget overview

Annual Budget € 36.7m

Budget Remaining € 12.2m ?

Benefactor Report / IBDs / AS / BMR

International Board for Doing Science 	
Annual Contribution € 9.0m	Present Aims ?
'Happiness' : 34% ?	• General Aim ! [Pursue precision Measurements]
Concerns: ? [The body (IBDS) do not feel you are furthering their aims]	• Funding Cycle Aim ! [Investigate Higgs Field]

All funding will be reassessed in (15) 'turns'

Budget assessment

Present Annual Commitment € 24.7m ?

Projected Annual Budget € 10.0m ?

Benefactor Report / IBDs / AS / BMR

Aperture Science 			
Group Aims	Proposal One	Proposal Two	Proposal Three
[Advance the frontiers of PP understanding]	[Examine Standard Model]	[Move towards new accelerator]	[Expand facilities]
? !	? !	? !	? !
Happiness: 52%	€ 10.0m	€ 13.7m	€ 8.2m

All funding will be guaranteed for (24) 'turns'

(The short term objectives presented with each funding 'proposal' essentially create a 'mission' for the user to attempt, with success/failure affecting future funds through the 'happiness' mechanic.)

- Popularity
 - Largely self-running on-site PR group generates infrequent publicity events for user; investment improves **popularity**.
 - Popularity 'generates' potential PhD students.

- Personnel:

Type	Primary Costs	Primary Benefits
PhD Student (No specialism)	• 1 unit of office space • Computing resources	• Add to project progress at a rate of 1 unit per turn
Research Assistant (1 specialism)	• As PhD * (2)	• Add to project progress at a rate of (3) units per turn • (5%) bonus to project progress added by all PhDs and RAs within specialist field • (Some) increase to the quality of a project within specialist field
Professor (2-3 specialisms)	• (10) units of office space	• Can lead projects, large quality boost for relevant specialism • Can otherwise be assigned as an effective (double value) RA • Open up specialist fields for education facilities

Acquiring staff: PhDs could be included in the office expansions and popularity effect, with RAs primarily available through education (small chance of joining directly). Professors 'hired' directly from the user from a pool of candidates.

Site Components (Aim: each component should feel distinct to user)

- Offices
 - House staff.
 - Upgrades for space and quality.
- Computing resources
 - Primarily used by PhDs and RAs for grunt work/research boost.
 - Upgrades increase efficiency boost, available in specific 'epochs' that are not researched by the player (eg, standalone -> network).
- *Power distribution/facilities*
- Workshops
 - Allow for on-site construction/maintenance of components
 - Upgrades for capacity and quality
- 'Educational facilities'
 - Generates PhD->RA conversion with random specialism; professors can set courses within their specialism to skew this.
 - Upgrades for capacity and success
- Construction/Civil Engineering
 - Not a permanent part of site, contracted out. Will appear on user interface on locations being developed for interaction.
 - Not upgradable.
- Accelerator apparatus
 - Each composed of a main construction project and several detector projects.
 - Not directly upgradeable; performance improved through the discrete projects that compose the apparatus.

Additional/Miscellaneous Concepts

Success

General progress through the game is led by objectives, largely based on funding bodies' desires (and competition with similar sites?). To give the game a sense of competition, the user should build a score based on ground-breaking research, the time taken to reach a given complexity of research and the quality of the findings taken at their facility.

Further information icons - consistent feature of the interface

- ! The (!) icon can be clicked by the user to bring up a more detailed explanation of the in-game value of the item it is beside.



The (?) icon can be clicked by the user to bring up a summary of the scientific concept of the item it is beside and pointing towards a more detailed explanation.

Length of the game

Beginning with a CERN-like site circa 1980, the game will last for (30) years with each turn representing a (season) for a total of (120) turns.

Nobel Prizes

Prizes acquired will improve the current popularity of the site (and so increase the number of PhDs available and the value of future funding) as well as add to the user's score.

Random Events

Random events have a chance of occurring at the beginning of each turn and may do something positive or negative to the player. They appear as a pop-up notification window informing the player about the event. One-off occurrences [Insightful Breakthrough! - Project X has been completed ahead of schedule] are recorded in the Notifications area of the main view, whilst events requiring decisions are recorded in the Events area for further attention.

Whilst the specific events given to the player should be random, where the events aren't being used to smooth out the difficulty curve [as in the example of an additional benefactor offering funding] the each user should receive a similar number of random events covering a balance of positive and negative.