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# LIBPF

## Roadmap

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## Introduction

This roadmap describes the planned capabilities of **LIBPF**, the C++ **LIB**rary for **P**rocess **F**lowsheeting. The current released version of LIBPF at the time of writing is 0.9.

### *Critical system requirements and targets*

LIBPF is a modelling tool for continuous processes. Its purpose is to make it possible to rapidly prototype and deploy small-footprint custom applications implementing computations for training, process engineer support, on-line process diagnostic, and data reconciliation. The necessary models (physical properties and unit operations) and tools (solvers, input/output) are gathered in the form of a C++ library; by linking to the library it is possible to create lightweight, special-purpose applications devoted to compute a specific process or process family. The objective of the continuing LIBPF development efforts is to enlarge the subset of real-life processes it can be applied to, increase its efficiency and improve the user friendliness. Along this path the following guidelines will be enforced:

1. Target easy-to-implement, high-return features first;
2. Avoid feature bloat and contain code size;
3. Retain portability;
4. Avoid dependency on monolithic libraries and technologies;
5. Maximize model reuse through object-oriented and generic programming.

## Milestone plans

The planned revision schedule is based on a 6-months revision cycle. There are six **major areas of development**:

1. User interface
2. Modelling
3. Physical properties
4. Resolution
5. Interfaces
6. Systems
7. Process Library



## **Version 1.0**

Estimated deadline: 2011/03/31

Key deliverables:

- User interface:
  1. What-if and sensitivity analysis UI: select list and ranges of variables, get results in tensor form, generate plots;
- Modelling:
  1. Particle Size Distribution in solid phases;
  2. Kinetic-controlled reactors;
- Physical properties:
  1. Simplified biomass characterization based on CHNO elemental analysis;
  2. Liquid-liquid and vapor-liquid-liquid flashes;
  3. OLGA TAB file generation;
- Resolution:
  1. Homotopy solver;
- Interfaces:
  1. SVG flowsheet connectivity output;
  2. Fully functional OPC Unified Architecture interface.
- Systems:
  1. Install and update calculations kernels (as subproducts) independent from User Interface component;
  2. All demos also available as downloadable OSX installers and Linux deb / rpm packages;
  3. Support installing UI in Windows without administrative privileges and UAC (User Account Control) compatibility in Windows Vista / Windows 7.
- Process Library:
  1. Distillation column demo;
  2. PC-SAFT based process model demo;
  3. PSOFC (proton-SOFC) demo;



## Version 1.1

Estimated deadline: 2011/09/30

Key deliverables:

- User interface:
  1. Problem configuration editing: change the values of selected string variables
    - requires smartenums support in UI;
  2. Display key data on streams and units in PFD tab on hovering;
  3. Filter database views with regexp;
- Modelling:
  1. Expand selection of dynamic models;
  2. Improve HTU/NTU based separation unit
  3. Compressor/expander with performance curves;
  4. Non-equilibrium flash;
- Physical properties:
  1. UNIQUAC activity coefficient model;
  2. GERG-2004 (18 components: Methane, Nitrogen, Carbon dioxide, Ethane, Propane, n-Butane, Isobutane, n-Pentane, Isopentane, n-Hexane, n-Heptane, n-Octane, Hydrogen, Oxygen, Carbon monoxide, Water, Helium, Argon) and GERG-2010 (same as GERG-2004 plus n-nonane, n-decane, and hydrogen sulphide) equations of state.
- Resolution:
  1. Optimization solver;
  2. 1.Tune for speed: skip Units of Measurements checks on innermost functions, improve on Qdouble construction overheads;
- Interfaces:
  1. Problem structure editing workflow: user will change the connectivity by editing a diagram, and automagically generate C++ code;
  2. Native Postgres database driver;
  3. Provide calculation kernel-side scripting interface;



- Systems:
  1. Internationalization: Support UNICODE identifiers and descriptions;
  2. Match the requirements for the «Works with Windows Vista Logo Program for Software», the «Designed for Microsoft Windows XP» Application Specification and the «Application Specification for Microsoft Windows 2000 for Desktop Applications»;
- Process Library:
  1. Semi-closed-circuit, refrigerated Liquid Ring Vacuum Pump demo;
  2. Cooling tower water circuit mass balance with salts accumulation and evaporation;
  3. Ammonia and CFC-based refrigeration cycle model;
  4. Nanoparticle production based on aerosol condensation process with inert gas recirculation;
  5. Biomass gasification with kinetic reactor model;
  6. Organic Rankine Cycle (ORC) power generation demo;
  7. Maleic Anhydride from Butane process demo;
  8. SOFC power generation system demo;
  9. GERG-2004 hydrocarbon mixture density and phase equilibrium demo;



## Version 2.0

Estimated deadline: 2012/12/31

- User interface:
  1. Model-specific forms generated from XML model descriptions;
  2. Interactive connectivity editing;
  3. OPC configuration editing with browsable UOM, models and tags;
- Modelling:
  1. Merge multihx and hx models;
  2. Tensor properties support and population balance based phase model;
- Physical properties:
  1. Liquid-phase reactive Flash (i.e. formaldehyde-methanol-water system or aqueous ionic species);
  2. Native PSRK / UNIFAC group-contribution predictive fugacity models;
- Resolution:
  1. Interface with BzzMath solvers;
- Interfaces:
  1. New model definition using XML: automatic generation of results visualization schema, header file, constructor and UI visualization helps;
  2. Interface to the VLXE SDK;
  3. Modbus process control system interface;
  4. Native MSSQL and Oracle database drivers;
  5. CAPE-OPEN interface for external thermo engine;
- Systems:
  1. Mobile light client (iPhone, Maemo, Symbian, Android ?);
  2. Port to QNX operating system;
  3. Implement as a controller block for 3S CoDeSys Automation Platform for the extensibility of PLC (programmable logic controllers);
  4. C++0x: delegating constructors, initializer lists, enum classes.