
16th FRUCT Conference

# Technology and Design Tools for Portable Software Development for Embedded Systems

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# Why do we need such technology?

1. “Two-in-one” developer is required:

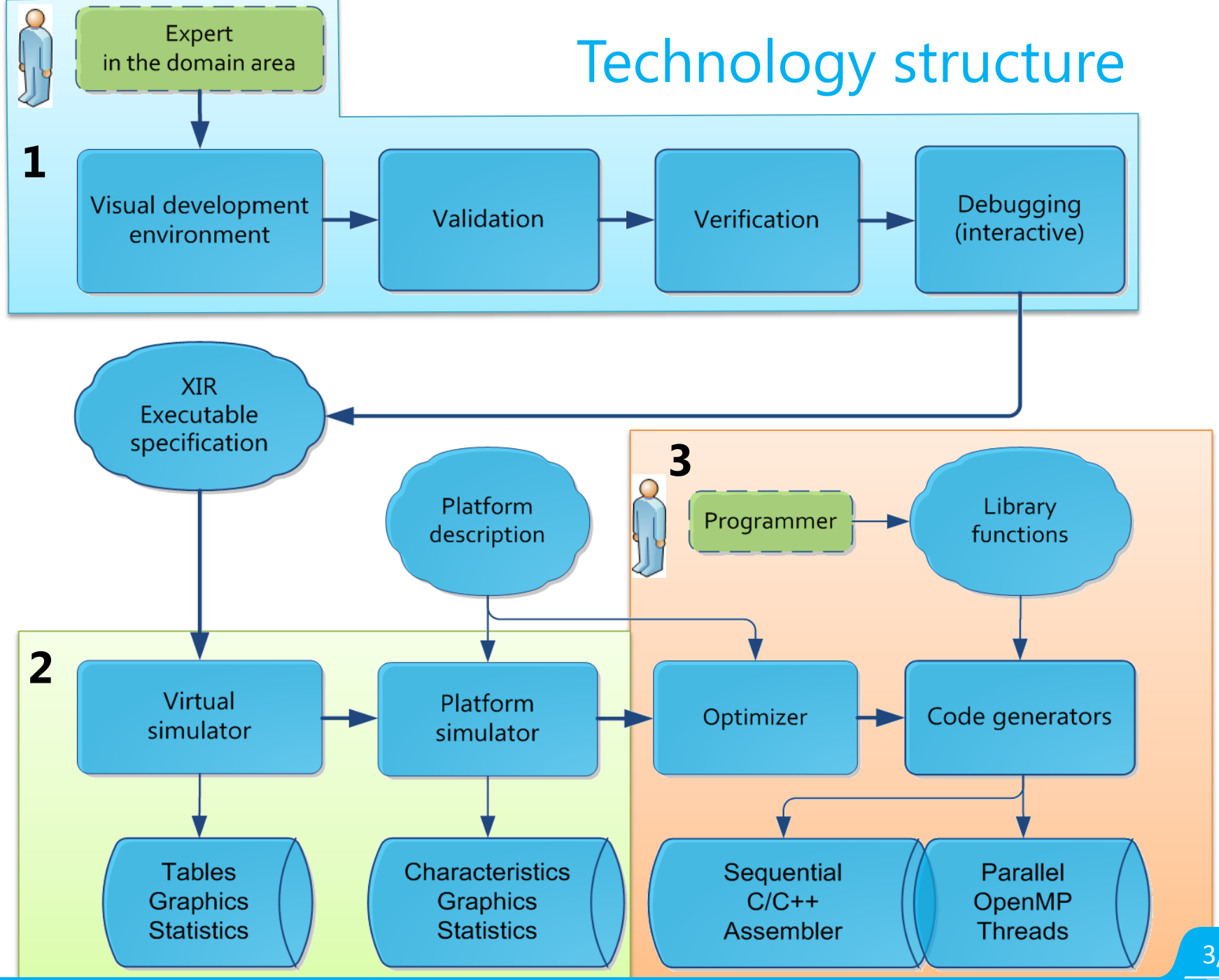
    skilled domain experts +  skilled programmer

2. Contradictive requirements to hardware platforms

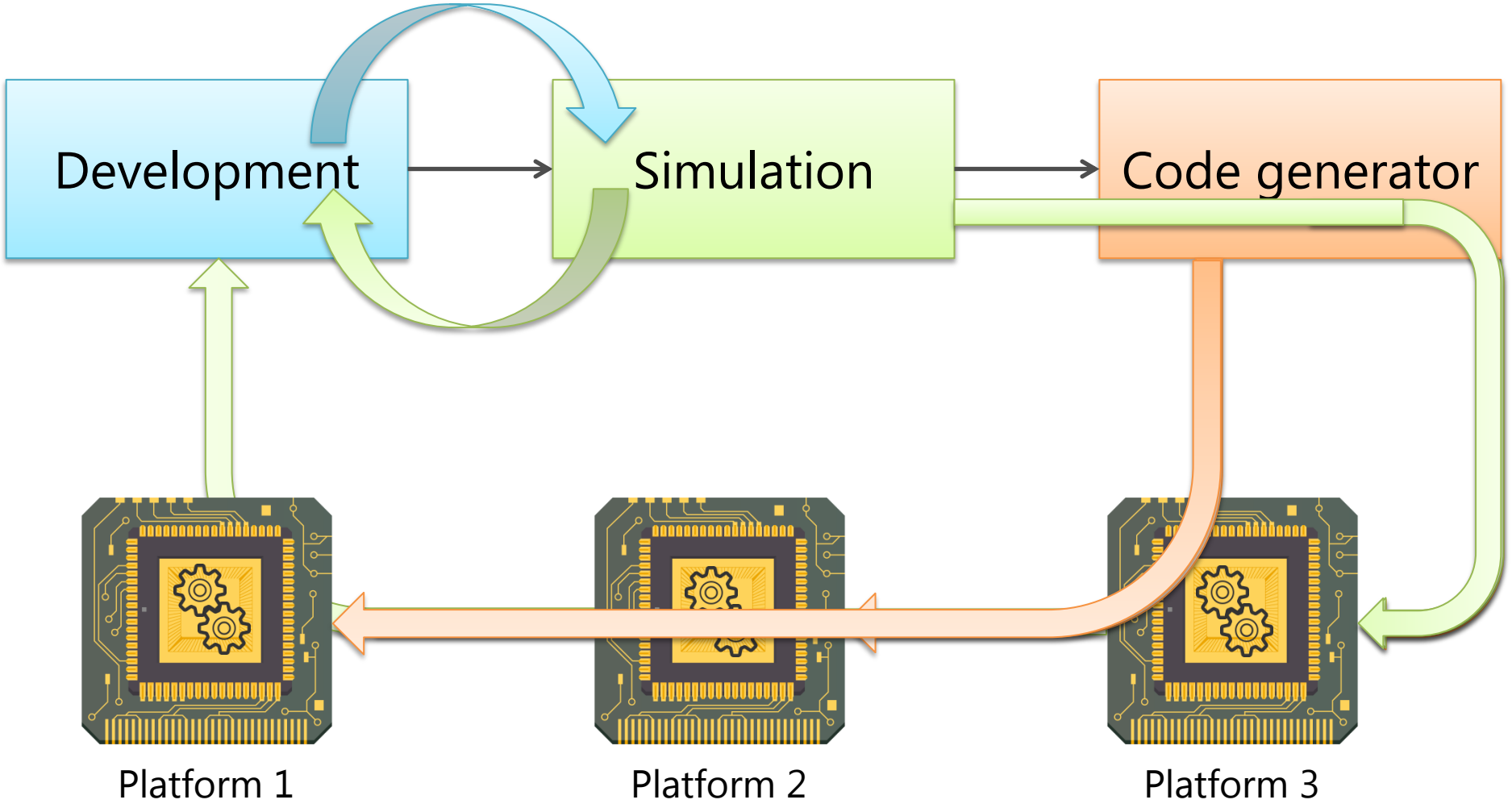
3. The development of an algorithm and program should be started before the selection of a specific platform configuration

4. Hardware platforms become out-of-date rapidly, but computation tasks that are executed on them changes rarely

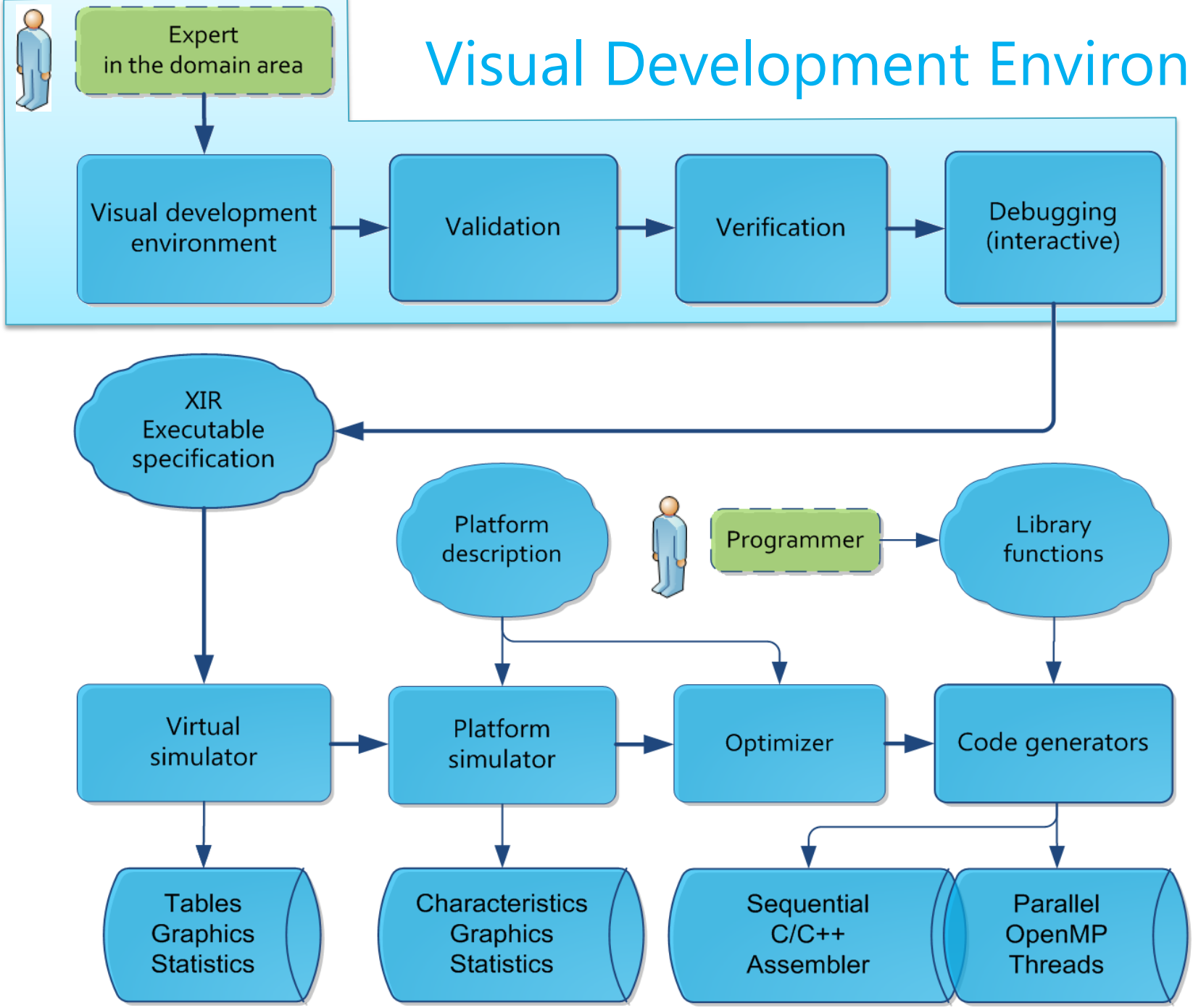
# Technology structure



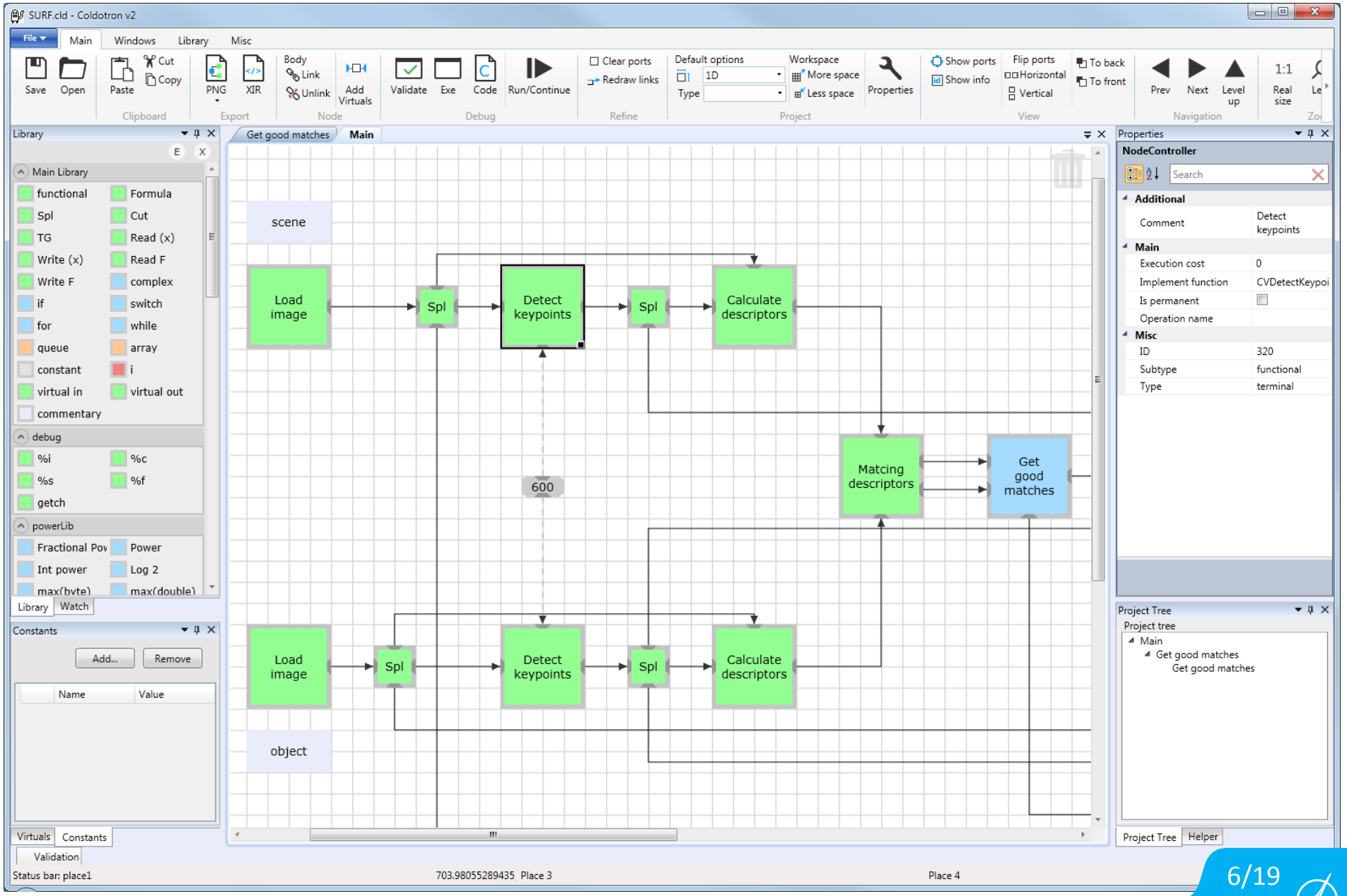
# The life cycle of programs for embedded systems



# Visual Development Environment



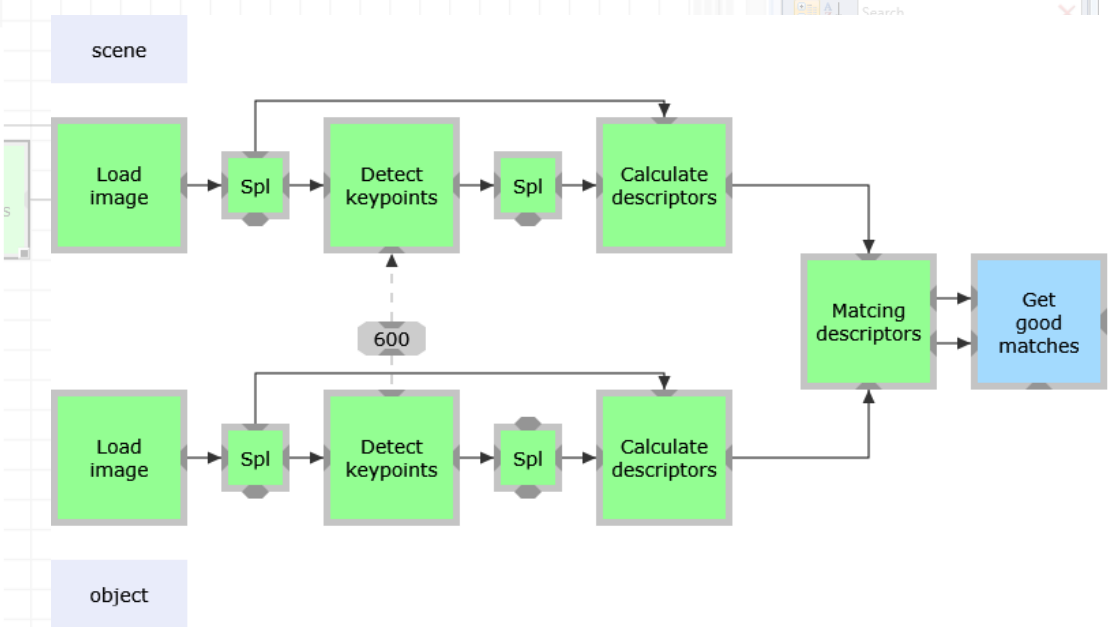
# Visual Development Environment (VIPE)



# Visual Programming Language (VPL)

Cognitive advantages:

- clear view of development process
- traceability of the dependency graph
- calculations management structure
- natural parallelism
- potential pipelining



# Asynchronous Growing Processes (AGP) formal computational model

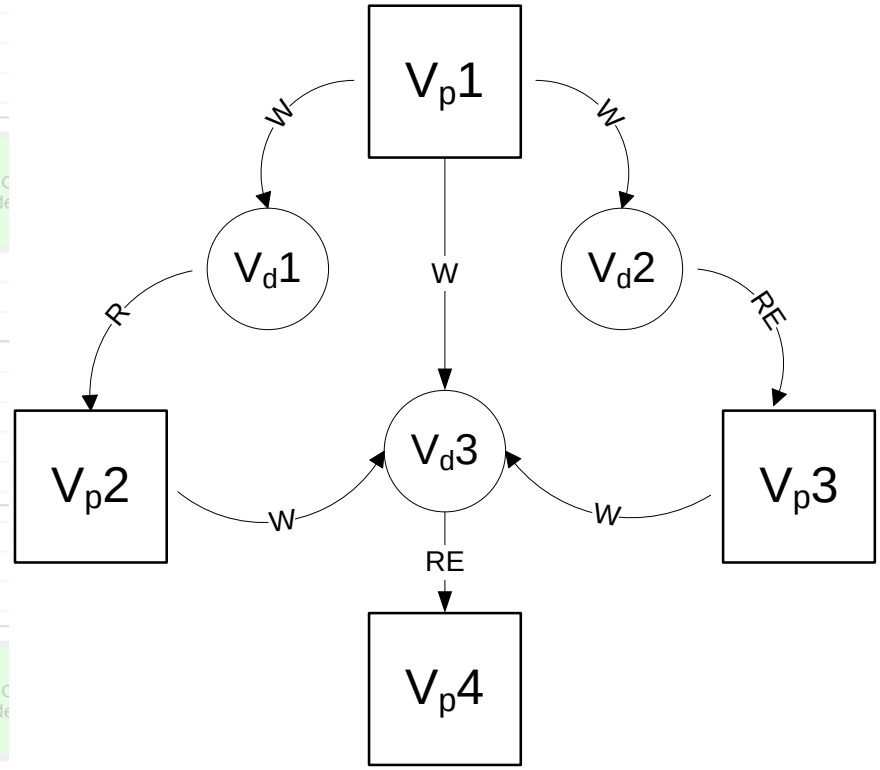
AGP defines:

- language syntax
- semantic of language objects
- control units

AGP provides:

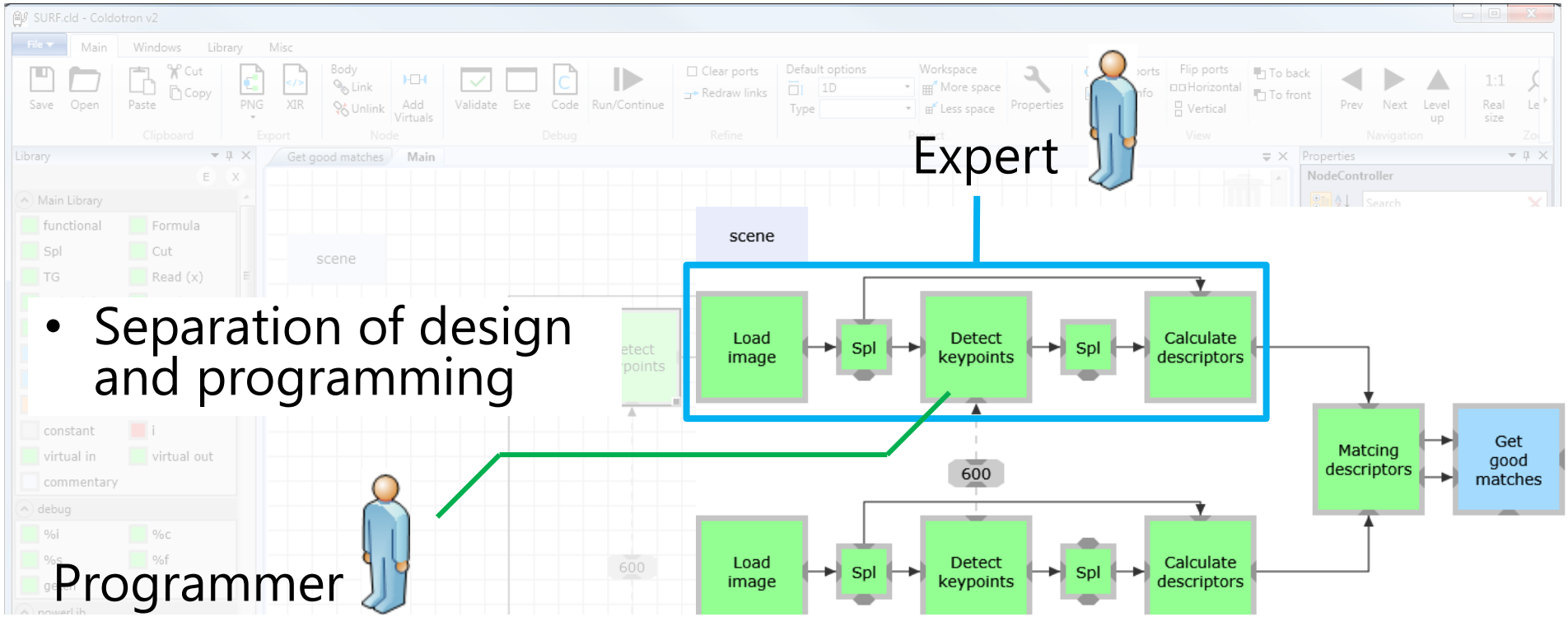
- formal verification
- debugging
- portability

Program scheme — oriented graph




*$V_p$ – operator vertex,*
*$V_d$ – data-object vertex,*
*W/R/RE* – arcs *(links)* marking

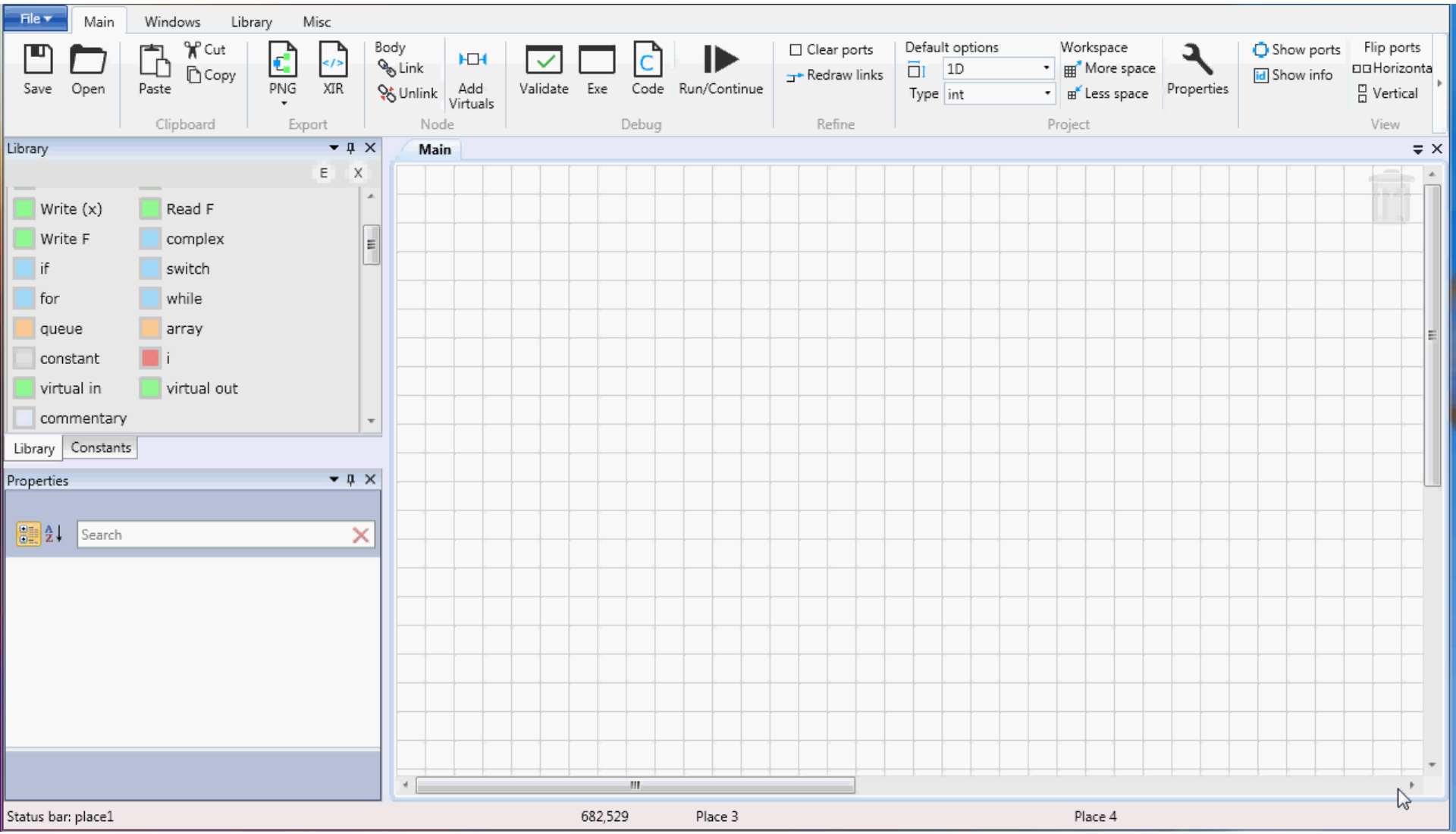
# Visual Programming Language (VPL)



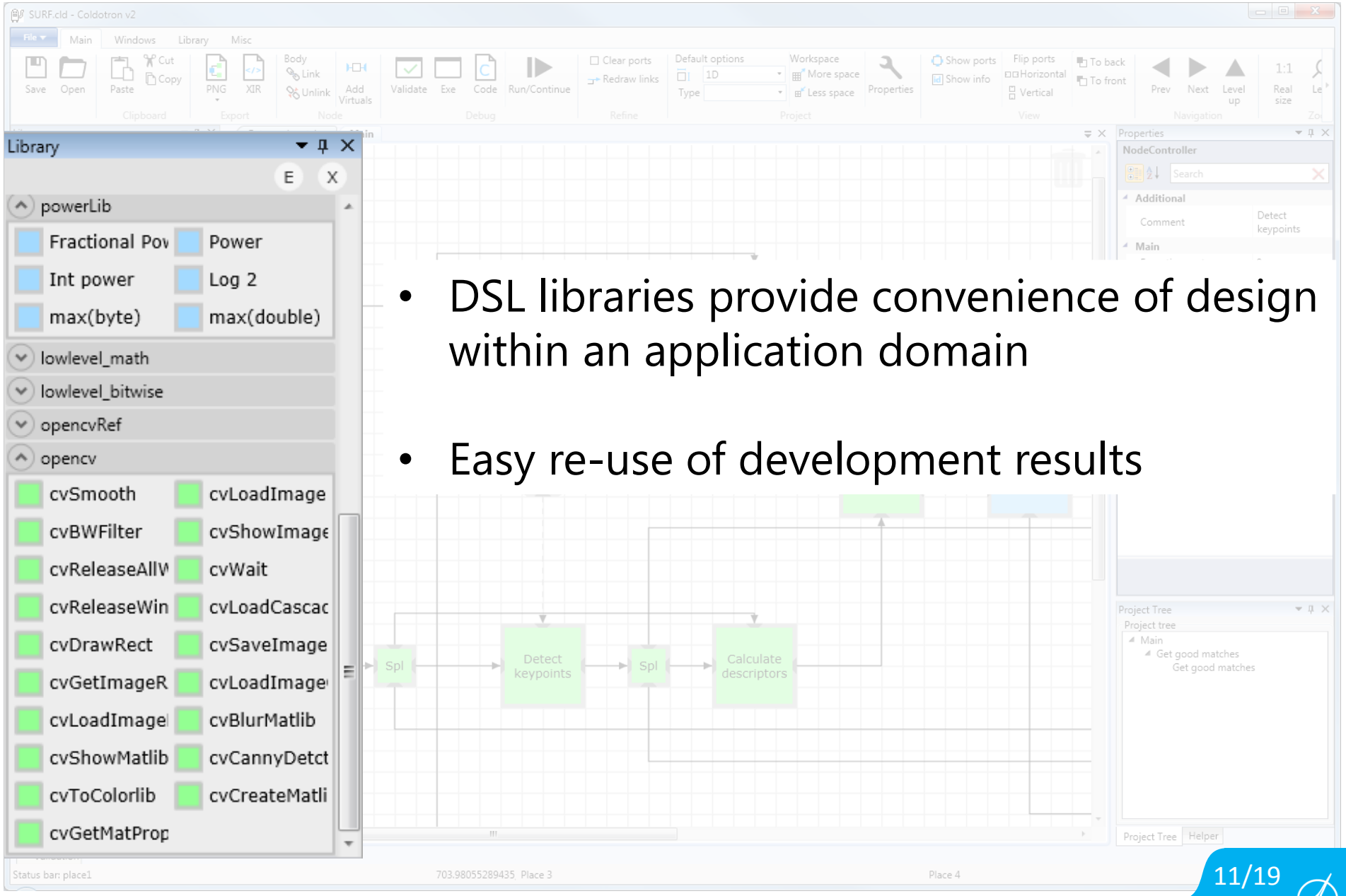

- Separation of design and programming

- Easy program development
- Easy changes in program structure
- No direct programmer influence on a program scheme
- Local appearance of code errors
- Possibility of auto-documenting of the program scheme
- Effective program maintenance during the whole lifecycle
- Decreasing of errors possibility without sacrificing program obviousness
- Flexibility and ease-of-change on any design stage

# Visual Programming Language (VPL)

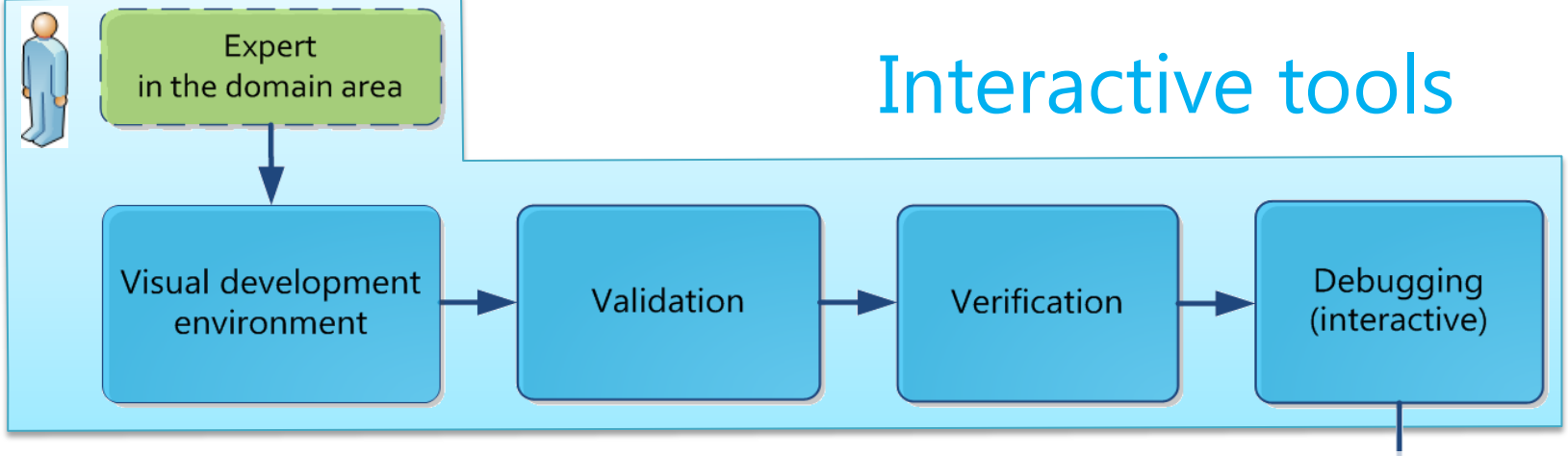


# Domain specific programming




- DSL libraries provide convenience of design within an application domain
- Easy re-use of development results

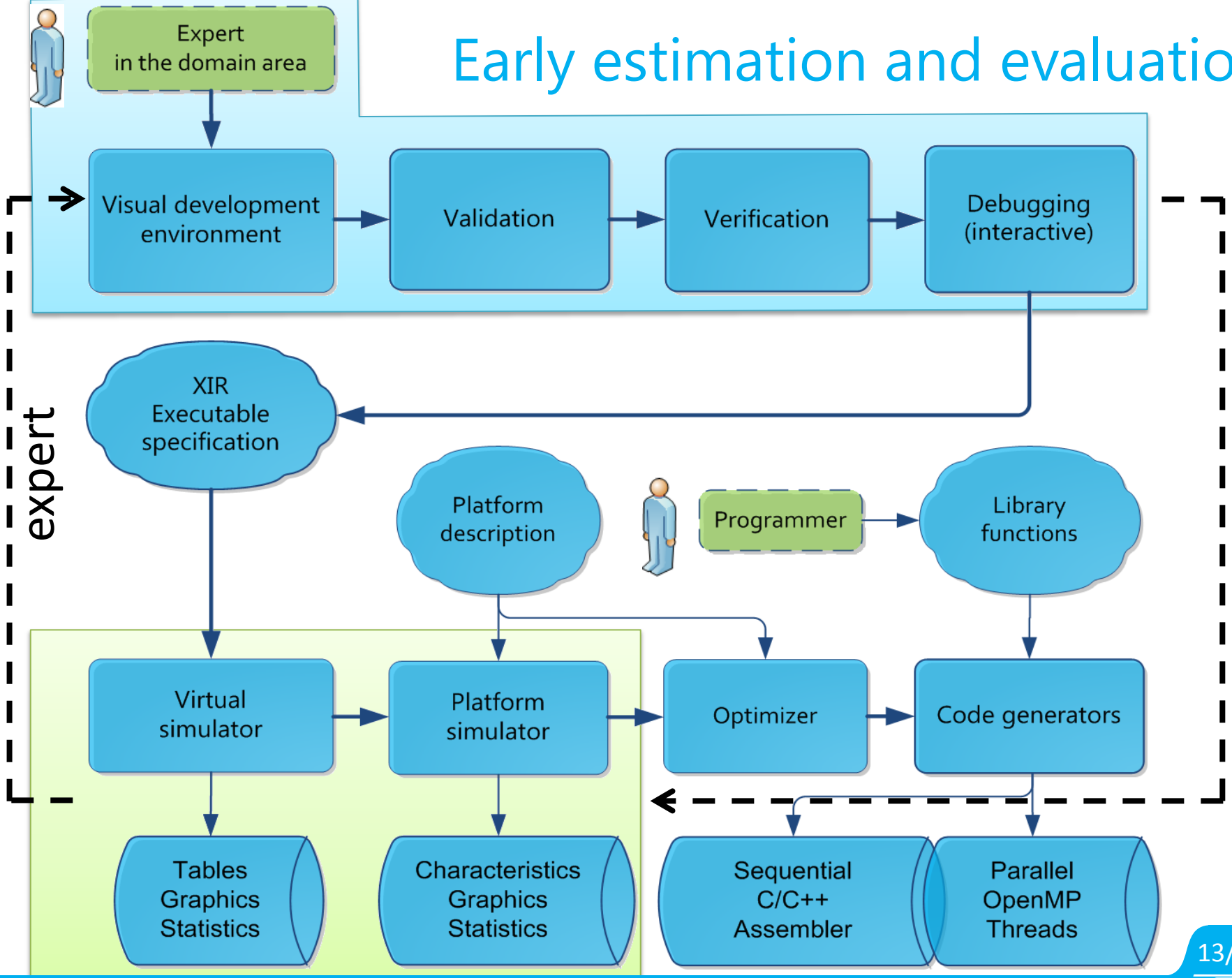
# Interactive tools



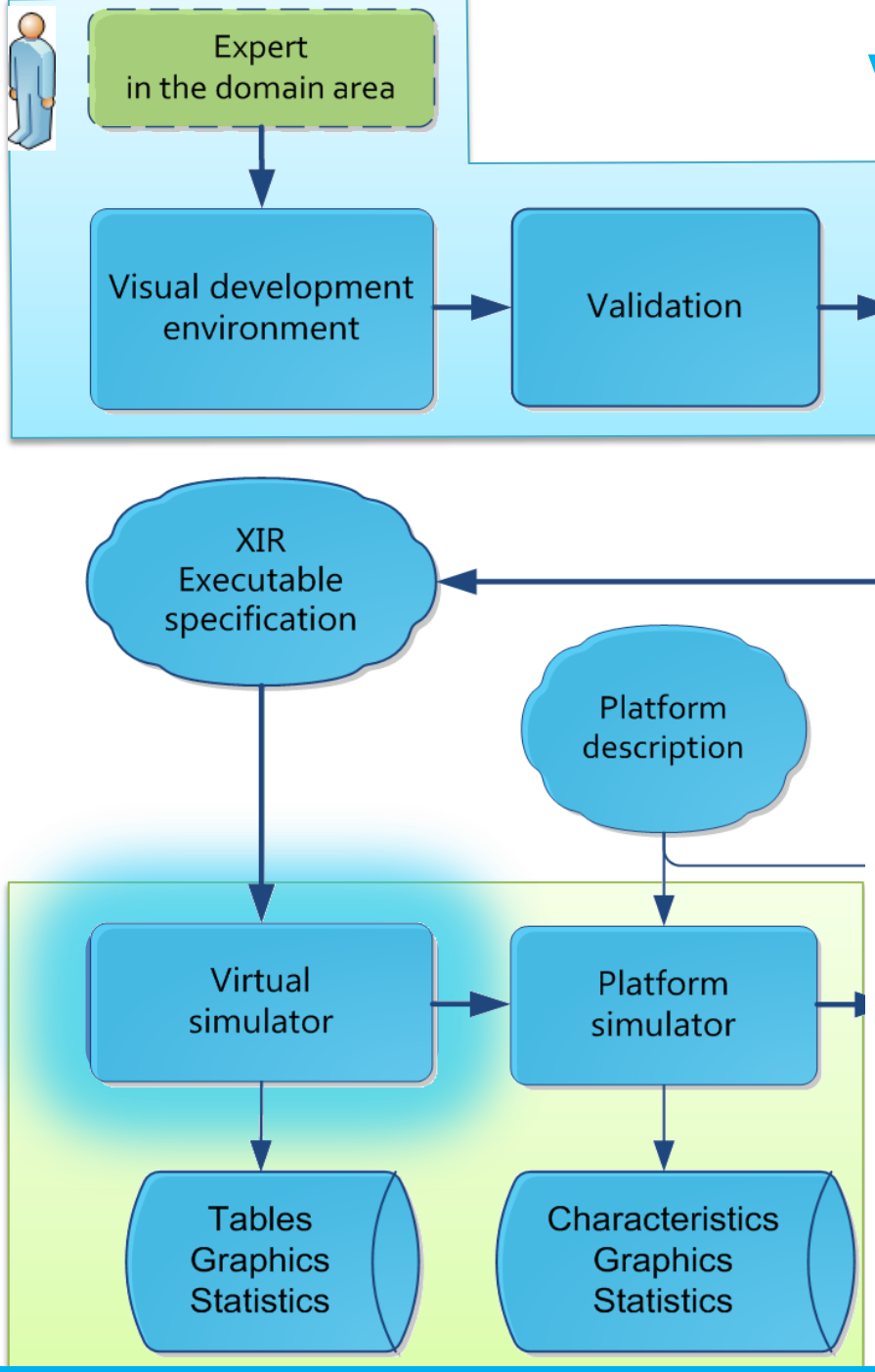

Development process support tools:

- scheme validation
- verification
- interactive debugging etc.

# Early estimation and evaluation



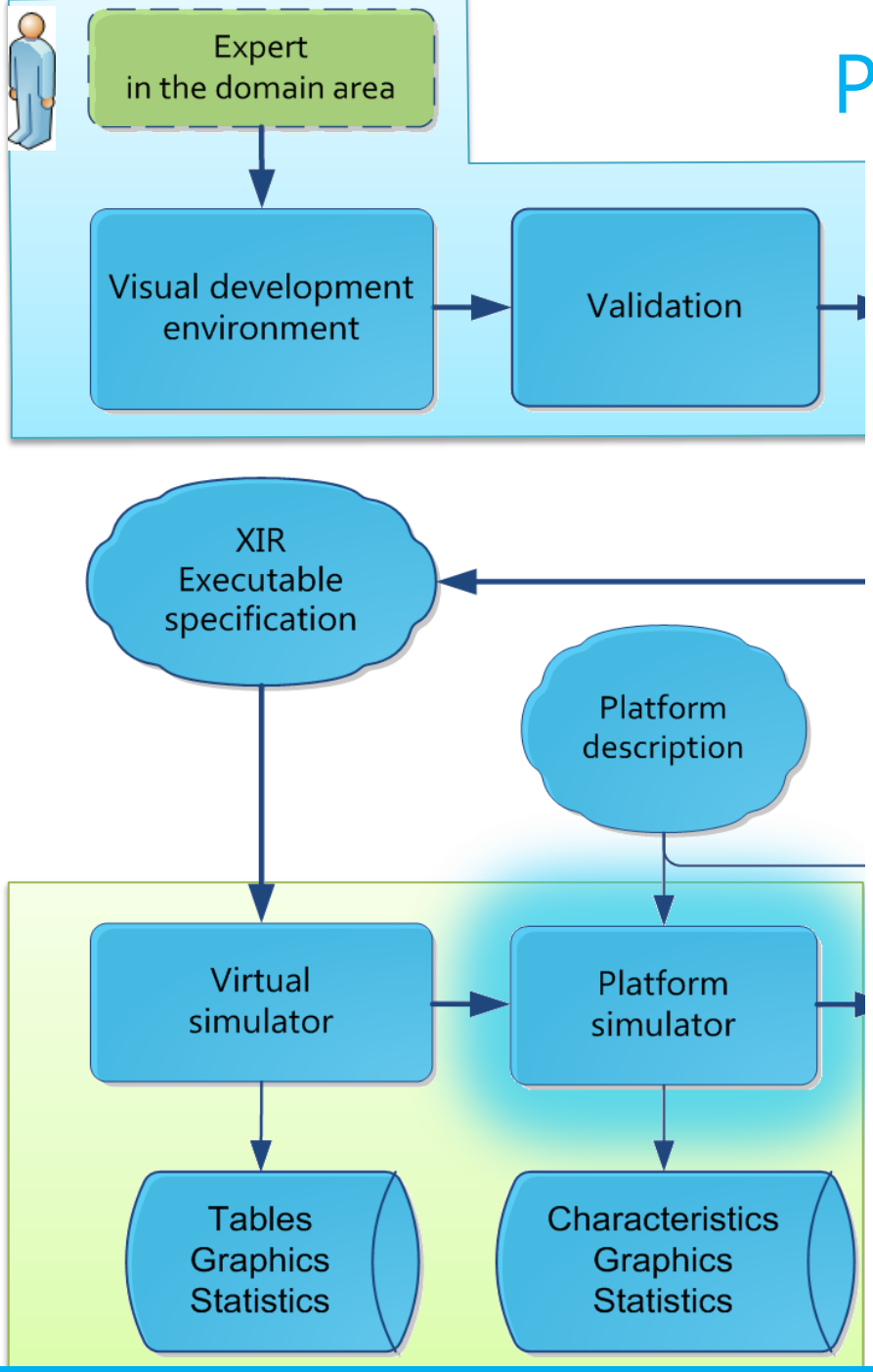
# Virtual simulator




Allows estimate:

- maximal possible parallelism
- computation space (amount of computations, used memory etc.)
- computation time
- amount and intensity of data exchange

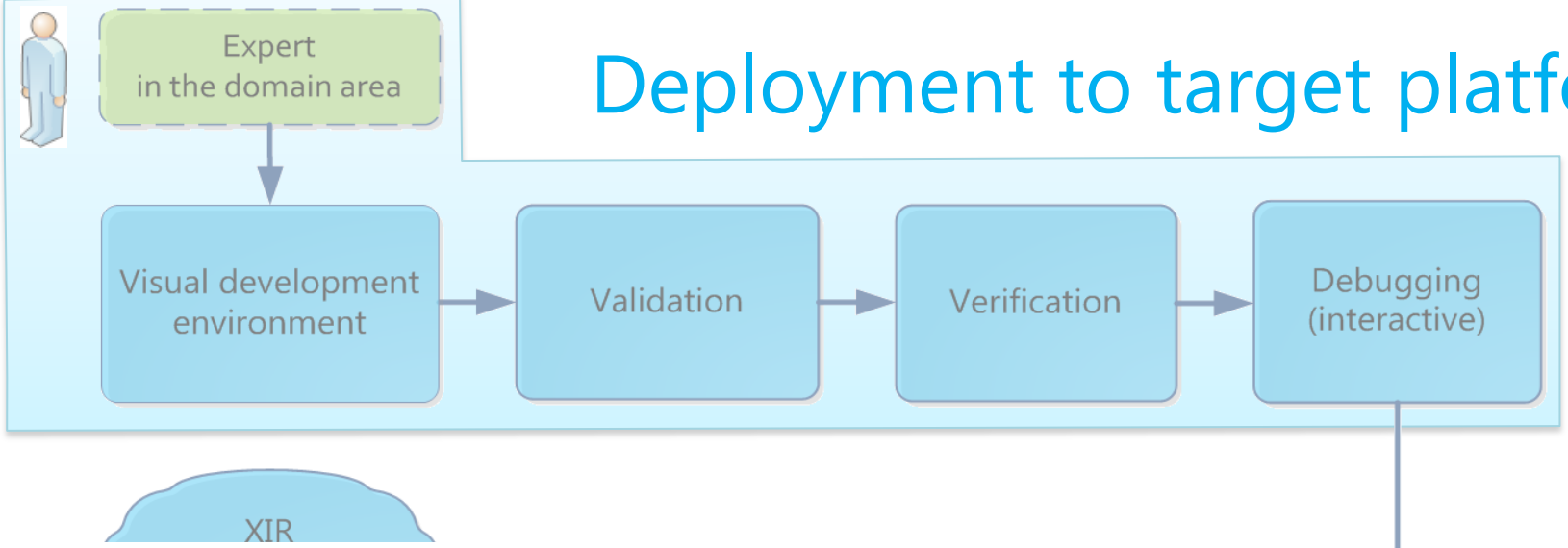
# Platform simulator



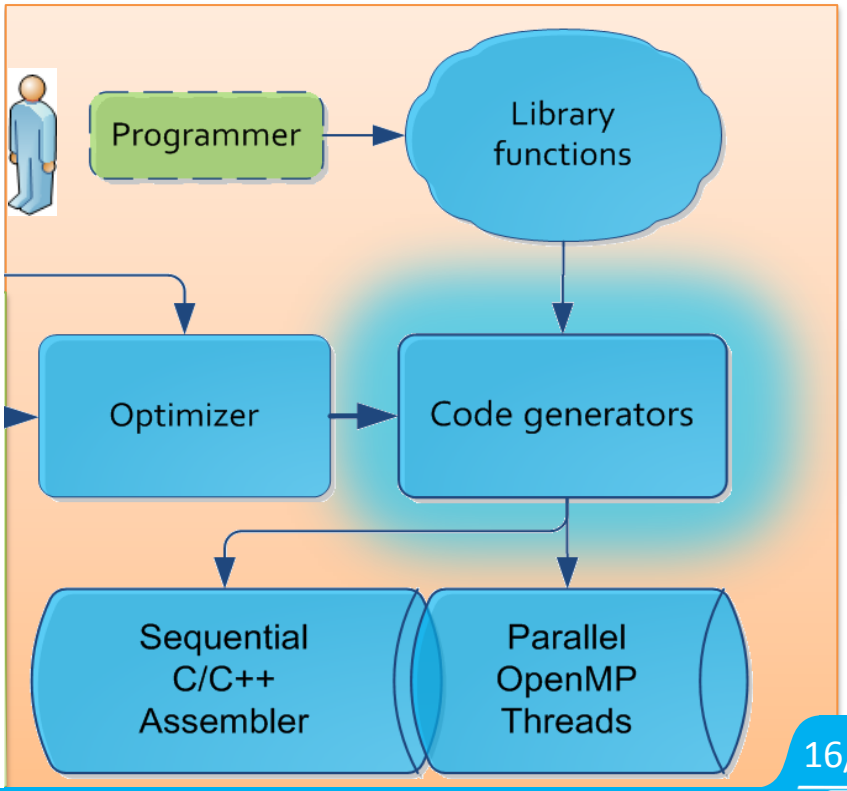

Allows estimate:

- requirements to embedded system cores performance
- requirements to embedded system cores memory
- computation cores occupation for the different allocation variants and occupation balance
- amount and intensity of data exchange
- effectiveness of hardware loading
- bottlenecks of hardware platform, program and tasks allocation

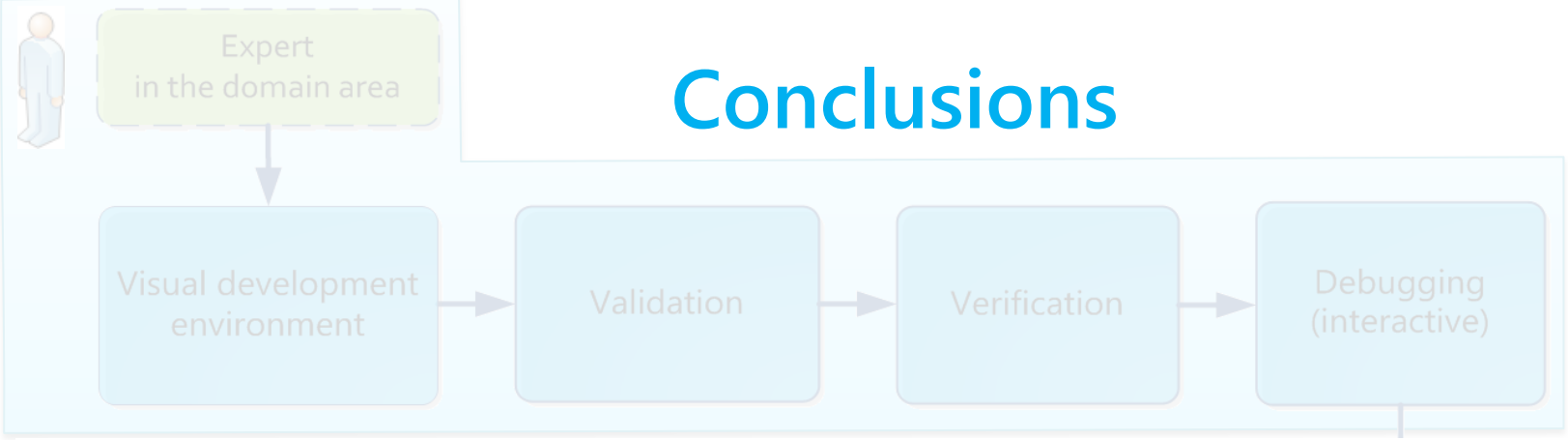
# Deployment to target platforms




- ANSI C
- C++
- Parallel OpenMP
- Parallel threads
- MPI
- Assembler MIPS, DSP
- Inhomogeneous systems



# Conclusions




- Supporting of a whole embedded software lifecycle
- The formal model based development ensures the equal execution of a debugged program in any runtime environment
- An algorithm is created and debugged once Parallel threads
- Scheme optimization for platform granularity
- Supporting of heterogeneous embedded systems (hardware blocks, accelerators, DSP)


Expert
in the domain area
Visual development
environment
Validation
Verification
Debugging
(interactive)
XIR
Executable
specification
Platform
description
Library
functions
Virtual
simulator
Platform
simulator
Optimizer
Code generators
Tables
Graphics
Statistics
Characteristics
Graphics
Statistics
Sequential
C/C++
Assembler
Parallel
OpenMP
Threads

# Thank you!