PLCopen: changing the world of industrial automation

Overview of the current activities and working groups

Eelco van der Wal
Managing Director PLCopen
Percentage of Software development costs in production systems (source: McKinsey)
Managing Complexity

100 – 10,000 – 1mio – 100mio Lines of Code
A hierarchy of abstraction
Abstraction via Function Blocks

MC_MoveAbsolute

- AXIS_REF
- BOOL
- BOOL
- REAL
- REAL
- REAL
- REAL
- MC_DIRECTION
- MC_BUFFER_MODE
- Axis
- Execute
- ContinuousUpdate
- Position
- Velocity
- Acceleration
- Deceleration
- Jerk
- Direction
- BufferMode
- Axis
- Done
- Busy
- Active
- CommandAborted
- Error
- ErrorID
- BOOL
- BOOL
- BOOL
- BOOL
- WORD
FUNCTION_BLOCK HYSTERESIS
VAR_INPUT
    XIN1, XIN2 : REAL;
    EPS : REAL; (* Hysterisis band *)
END_VAR
VAR_OUTPUT
    Q : BOOL := 0
END_VAR
IF Q THEN
    IF XIN1 < (XIN2 - EPS) THEN
        Q := 0 (* XIN1 decreasing *)
    END_IF;
ELSIF XIN1 > (XIN2 + EPS) THEN
    Q := 1; (* XIN1 increasing *)
END_IF;
END_FUNCTION_BLOCK
### Information hiding via Function Blocks

<table>
<thead>
<tr>
<th>AXIS_REF</th>
<th>Axis</th>
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<tr>
<td>BOOL</td>
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<td>Deceleration</td>
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<tr>
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</tbody>
</table>
Axis_Ref with 1 FB

Axis1

FB

Task Manager

Time or event driven

Axis_Ref Structure

Conversion

I/F

Drive
Axis_Ref with 2 FBs

Axis1

FB1

FB2

Task Manager

Time or event driven

Axis_Ref Structure

Conversion

I/F

Drive

Drive
HW Independence via Function Blocks

Encapsulation / Information Hiding

Software View

Hardware View

I/F
Sercos Drive
Motor
E

I/F
PWM
Drive
Motor
E
Encapsulation: Webcutting

Synchronization of web feeding & rotating cutter
Mechatronic solutions

Mechanical solution.

Control solution
Decomposition and Reuse
Sequential Function Chart, SFC
Time-to-Market
via flexibility in equipment and process

Asset utilization
minimal finished good inventory

Flexibility in Manufacturing
process followed by packaging to provide end product

Overall Equipment Effectiveness, OEE
Mapping OMAC State Diagram to SFC

Diagram showing the mapping of OMAC state diagram to SFC.
PLCopen
for efficiency in automation

How?
PLCopen as a World-wide association

Main Office in Europe

Office in North America

Office in China

Office in Japan
Organization

General Meeting, BOM, MD

TC1  TC2  TC3  TC4  TC5  TC6  PC1  PC2  PC3  PC4  PC5

TECHNICAL

COMMITTEES

PROMOTIONAL
TC1 Standards: the basis

IEC 61131-3

Harmonizing the way people look to control
## IEC 61131 Parts

<table>
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<tr>
<th>Project</th>
<th>Title</th>
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<tr>
<td>61131-1, Ed 2.0</td>
<td>General information,</td>
<td>2003-05</td>
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<tr>
<td>61131-2, Ed 3.0</td>
<td>Equipment requirements and tests,</td>
<td>2007-07</td>
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<td><strong>61131-3, Ed 3.0</strong></td>
<td><strong>Programming languages</strong> <em>(Currently CDV - Committee Draft for Voting)</em></td>
<td><strong>2012+5</strong></td>
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<td>61131-4, Ed 2.0</td>
<td>User guidelines (TR),</td>
<td>2004-07</td>
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<td>61131-5, Ed 1.0</td>
<td>Communications,</td>
<td>2000-11</td>
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<tr>
<td><strong>61131-6, Ed 1.0</strong></td>
<td><strong>Functional safety for PLC</strong> <em>(Currently CDV - Committee Draft for Voting)</em></td>
<td><strong>2012+5</strong></td>
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<td>61131-7, Ed 1.0</td>
<td>Fuzzy control programming,</td>
<td>2000-08</td>
</tr>
<tr>
<td>61131-8, Ed 2.0</td>
<td>Guidelines applic. &amp; implem. progr. languages (TR),</td>
<td>2003-09</td>
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<tr>
<td>61131-9, Ed 1.0</td>
<td>Single-drop digital communication interface for small sensors and actuators (SDCI) aka “IO-Link” <em>(Currently CD - Committee Draft)</em></td>
<td><strong>2012+5</strong></td>
</tr>
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</table>
Why include Object Orientation in the 3\textsuperscript{rd} edition?

Main reason:
To link better to the scared resources of engineers in the future

We’d better adapt to them then vice versa
IEC 61131-3

Harmonizing the way people look to control

and PLCopen extends this basis
TC2

Functions and Function Blocks

- Harmonization of libraries of reusable components
- Example: Motion Control
Status PLCopen Motion Control

- Part 1 – Function Blocks for Motion Control
- Part 2 – Extensions
- Part 3 – User Guidelines
- Part 4 – Coordinated Motion
- Part 5 – Homing procedures
- Part 6 – Fluid Power
- Over 27 companies certified with over products (check website for full list)
Current PLCopen Motion Control Releases

- Merge of Part 1 and Part 2 – Motion Control 2.0
- Release of Part 5 – Homing
- Update of Part 3 – User Guidelines
- Part 6 – Extension for Fluid Power
The next step:
Adding Safety (TC5)
(at machine level)
Reasons to merge – a changing environment

- Too many dialects, too many standards, including IEC 61508 and IEC 62061;
- Additional governmental requirements increasing the liability issues;
- No independent training material
- Trend to software solutions
- Too much done by machine builder themself
- Growing market expected
Reasons to merge – a changing environment

- The tendency to move from one motor (master axis) to multiple axes, driven by mechatronic solutions;
- The availability and acceptance of digital networks with safety functionality built-in;
- The inherent move from hardwired safety functionalities to software solutions;
- The increasing importance of safety related issues regarding personnel and machines.
TC5 - Safety : New initiative

- Focused to material presses used for metal forming
- Extensions for Presses will be published as Part 5
PLCopen

Combining Logic, Motion and Safety

Providing Structuring, Decomposition, Reuse and less training
TC3 - Benchmarking

A benchmark is a reproducible, portable test to measure the performance of a given system in comparison to other systems.
TC3 - Benchmarking

There are two main objectives to use a benchmark:

1. To estimate the performance of the PLC in your own application

2. To compare the performance of the PLC with other PLCs and find out the specific strength and weakness of a given system
Benchmarking (TC3)

Two different sets of benchmarks defined:

1. 5 different types of applications, which are typical for the usage of a PLC.

2. Measures each language feature of the IEC 61131-3 separately
Communication (TC4)
TC4 Communication

- OPC UA specifies HOW
- PLCopen specifies WHAT
TC6 – XML

Opening up the development environments
by specifying XML formats for IEC 61131-3
XML (TC6)

Producer of graphical and logical information

Other Development tool

Development tool

Consumer of graphical and logical information

Other Development tool

XML
AutomationML™ describes mechatronical objects

- Topology
- Geometry
- Kinematics
- Motion Planning
- Behaviour

AutomationML™ is free and open
## AutomationML™ incorporates successful standards

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<th>Aspect</th>
<th>Format*</th>
<th>Organisation*</th>
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<td>CAEX (IEC 62424)</td>
<td>IFC, DKE</td>
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<td>Geometry</td>
<td>COLLADA</td>
<td>KHRONOS</td>
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<td>Sequencing</td>
<td>PLCopen</td>
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* Snapshot 11/2007
The link to other simulation tools

- MatLab / Simulink
- Calculate / simulate complex behaviors
- like a 80 synchronized motors in one packaging machine
- or like the control of windmills
PC2 - Training

Important to create sufficient human resources capable to create and innovate
Overview

- PLCopen logic
  IEC 61131-3
  ST LD IL SFC FBD

- PLCopen motion control

- PLCopen safety

- PLCopen OPC UA
  ERP  MES  HMI
  IEC 61131-3
  CTRL

- PLCopen XML
  Extensible MARKUP LANGUAGE

- PLCopen reusability level
  No. 0000
  21.06.2001
  DS: 26 of 26

- PLCopen Certification Training
  IEC 61131-3

- PLCopen Benchmarking
More Information... 
and to download the specifications (f.o.c)

www.plcopen.org

Free-of-Charge electronic Newsletter ‘PLCopening’ (in English)
email: evdwal@plcopen.org
Thanks!

Help us helping you – think about joining