How open standard based tools can support the future of flexible manufacturing

Standards

IEC 61131
IEC 61804-2
IEC 61508
EN 50128
IEC 61508
EN 50128
IEC 61490
IEC 61490
ISA S88
ISA S88
XML
XML
OPC
OPC
ISA S85
ISA S85

Engineering is all about standards?
The quest for standards

- Domestic Power
  
  *Standard Locally (country, vendor...), incompatible elsewhere*

- Laptop power packs
- Cell phone power packs

  *No Standard at all...*

Standards in the automation market

- IEC61131, not a single vendor’s product can use the code of a competitors product
- IEC61131 - a compromise to accept all the languages use at the time as part of the standard
  - was a major step forward in terms of training and programming
  - did not facilitate the integration of systems from different vendors
Standards in the automation market

- Field networks are incompatible, you have to take sides
- All the major automation vendors are designing their own global architecture platforms
  - Industrial IT
  - Archestra
  - Unity
  - TIA
- IEC 61804-2: The FDT/DTM and EDDL is about to be resolved by a compromise

Standards in the automation market

- HMI: you cannot reuse in a graphic animation produced by a competitors product
Attempts to resolve the issue

- Vendors offer to other to adopt their solution
- Or, once they had gained sufficient market ground have turned their field networks over to independent organisation to make them become standards
- Organisation such as PLC Open have made some recommendations to manufacturers to use common data formats such as XML or common function blocs.

IEC Statement

Standards

IEC's international standards facilitate world trade by removing technical barriers to trade, leading to new markets and economic growth. Put simply, a component or system manufactured to IEC standards and manufactured in country A can be sold and used in countries B through to Z.
Standards

IEC's standards are vital since they also represent the core of the World Trade Organization's Agreement on Technical Barriers to Trade (TBT), whose 100-plus central government members explicitly recognize that international standards play a critical role in improving industrial efficiency and developing world trade. The number of standardization bodies which have accepted the Code of Good Practice for the Preparation, Adoption and Application of Standards presented in Annex 3 to the WTO's TBT Agreement underlines the global importance and reach of this accord.

IEC Statement

Standards

IEC standards provide industry and users with the framework for economies of design, greater product and service quality, more inter-operability, and better production and delivery efficiency. At the same time, IEC's standards also encourage an improved quality of life by contributing to safety, human health and the protection of the environment.
Benefits and Challenges of open standards

- Interoperability
- Portability
- Configurability
- Usability

Agile manufacturing ↔ Agile Automation

- A fantasy?
- Will that have to come from a single vendor?
- Will fierce competition prevent it at the end?
The Future Agile train

- All electronically driven
- We need to replace the middle wagon
- All we have is a Wagon from a different manufacturer not designed by default to work with the other two

A major step forward in the evolution of automation

The last real evolution in the world of automation that had an impact on how engineers would design and develop control systems were:
- The introduction of PC based HMI in the early 90’s.
- The standardization on IEC61131 as the programming environment for automation.

These had a direct impact on the accessibility of automation technology to everyone.

Since then, small improvements have been seen such as the introduction of new communication protocols and variations of control systems, ( PLC’s RTU’s DCS’s etc ) to address specific needs.
A major step forward in the evolution of automation

- The IEC61499 standard defines how function blocks can be used in distributed industrial processes, measurement and control systems. It is the result of more than 10 years of work by the International Electrotechnical Commission.
  - This is changing forever the way to design control systems.
- IEC61499 goes beyond the IEC61131 standard by offering a model that allows for applications to be distributed over multiple resources.
  - The interaction between cooperating systems shall not be subject to the imagination of the control engineers
  - A graphical representation of these interactions using Function Block Diagrams would intuitively help to specify the behaviour of such a system.

IEC 61499 helps resolve 5 industry problems

- Provides a high level approach to the design of distributed control systems.
  - Simplifies the programming of distributed controllers
  - Makes maintenance inherently intuitive
  - Uses graphical description and representation familiar to the engineers in our industry (Function Blocks)
- Introduces rigorous relationships between cooperating controllers
  - Controls the execution flow
  - Guarantees data integrity
  - Normalizes the interlock relationships
- Introduces the concept of objects in the industrial control environment
  - Association of object and devices is made easy
  - Facilitates reconfiguration yielding to agile manufacturing
  - Promotes and supports the creation of encapsulated Intellectual Property (control technology know-how)
  - Understanding and Implementation of Objects concept is made easy to all engineers (design, maintenance, operation)
- Complements the Fieldbus protocols by providing control environment for the networked elements.
- Implies interoperability and configurability of devices in multi-vendor environments
The Future Agile train

*My agile train controlled with IEC61499*
The Future Agile train company

Implementation of a traditional control system

Communications or interlocks are done with function blocks, message datagram or sometimes with I/O interconnection. They are implemented manually and different from engineer to engineer.
In using the IEC61499 standard, one can design an application distributed over multiple resources and spread over multiple devices (known as Configs under IEC61131). These applications would be regulated through IEC61499 function block diagrams and their collaboration is then clearly and rigorously defined.

The devices could be plc’s, micro-controllers or even intelligent field instrumentation such as flow meters or valves.
Immediate IEC61499 Benefits

- Regulates the flow of control decisions for an interacting distributed control system
- Ensures integrity of the distributed application
- Provides for consistency of the data
- Provides means to ensure synchronous operation between devices
- Normalizes the interlock relationships
- Eliminates the need to have separate synchronization schemes
- Eases considerably the development of robust control systems
- Eases drastically maintenance of distributed control systems
- Provides mechanism for spreading an application and controls its execution in a multi-resource and multi-device environment.

Open Global Standard

[Diagram showing XML, portability, configurability, and interoperability between devices and software tools]
ARC (Automation Research Corporation) in Boston, Mass stated in one of their white papers

“IEC 61499 will shape next generation of automation systems.”

And in their recommendations

• The evolutionary capability of IEC 61499 adds a new dimension to automation, probably the most significant for the discrete industries is the "lot of one" (mass customization) and in the process industries "zero unscheduled shutdowns" (maximum utilization). What could it mean to you?
• The specification is complete and being implemented by some suppliers, ask your primary suppliers if they have plans to offer products based on IEC 61499.

Source: ARC-Setting the Stage for the Next Generation of Automation Control System Software: A Discussion of IEC 61499

IEC61499 is a genuine open standard

• It is not a spin off of a specific vendor technology
• It meets the expectations of the IEC
• It is brand new and unbiased
• It does not rely on proprietary technology
• It can be implemented in its entirety by any automation vendor
We have unique opportunity to make history

- Stick to the letter of the standard
- Enhance it over time
- Make sure we all adhere
- Make sure it does not restrict creativity
- IEC61499 is simple and self-regulating, do not introduce complexity

My name is: Julien Chouinard

Founder and Managing Director of ICS Triplex
ISaGRAF

We have been developing leading edge automation technology since 1984
ICS Triplex ISaGRAF: An Introduction

- Originated in 1984
- 37 employees
- 23 years’ experience in Automation Software Technology
- Multi-industry experience
- Long-term support provided worldwide through local offices, integrators and representatives
- The most widely used Automation Software Technology in the world

Products

- ICS Triplex ISaGRAF has 2 Products
  - ISaGRAF (PAC Firmware and Configuration environment)
    - Basic
    - With advanced options
  - Hibeam (embedded Web based HMI)
ISaGRAF proposition

ISaGRAF Workbench
IEC61131 and IEC61499
Development environment

Controller Firmware

TIC Code
or
C ANSI
Source Code

ISaGRAF Workbench
IEC 61499
ANSI C

IEC61131 Languages
- Sequential Function Chart
- Structured Text
- Ladder Diagram
- Instruction List
- Function Block Diagram

First IEC61499
- IEC 61499
- Plus
- Flow Chart
- ANSI C

ISaGRAF proposition

ISaGRAF Workbench
IEC61131 and IEC61499
Development environment

Controller Firmware

TIC Code
or
C ANSI
Source Code

ISaGRAF Workbench
IEC 61499
ANSI C
ISaGRAF Concept

Automation software for stand alone, multi-scanning or distributed applications.

ISaGRAF Hardware Model
ISaGRAF Resource Model

ISaGRAF: Hardware Independent

Any HW platform...

ColdFire, MPC, PowerPC, ...

Armi7, Arm9, StrongARM,...
**ISaGRAF: High portability**

Any OS ...  
Without OS  
Proprietary OS  

WinNT/2000/XP, WinCE, ...

**ISaGRAF: Form factors**

Tiny Controllers  
And much More...  

Small Controllers  
RTUs/PLCs/PACs  
PC 104  
VME Boards And Racks  
Panel PCs  
Intelligent Boards
ISaGRAF: a natural choice for the automation vendors or industrial OEMs

- Bombardier Trains
- Alstom TGV
- Daewoo robotic
- Kingfisher Plus+ RTU
- SIXNET IPm Controller & RTU
- E-Tility Automation PLC
- ICP DAS ISK 8000
- GE Energy Substation Control
- Trusted ICS Triplex
- Charles De Gaulle Aircraft Carrier

Customers and Licenses

- Over 500,000 firmware licenses sold
- Over 45,000 Workbenches worldwide
Taking IEC61499 to it's full capacity

• Building libraries of function blocks and for devices and use those appropriate in due time. (example, flowmeter for different fluids with specific FB for each kind of fluid; FB provided by the manufacturer.)

• Redesigning part of a plant at a high level, with only the interactions between a few devices that are modified without affecting the whole process.

• Embedding Intellectual Property in IEC61499 FB and using those within composite function blocs or in 61499 diagrams

• Integrating “Alien” blocks within an IEC61499 diagram seamlessly.

• Driving a community of IEC61499 compliant device manufacturers and integrating the various heterogeneous components as part of a coherent system.

• Having IEC61499 logics jump between networks and protocols and platforms.

Standards and Compliance

IEC61499 compliant
• First to be officially certified as IEC61499 compliant by an independent certification company (TUV Rheinland). Full compliance list available on our website.

IEC61131-1 and –3 compliant
• First to be officially certified as IEC61131 compliant by an independent certification company (TUV Rheinland). Full compliance list available on our website.

• Support all languages and data types

Innovative
• First to offer IEC61131 full software model 8 years ago. First to support new IEC61499 standard.
How can ISaGRAF contribute

- Actively promote IEC 61499
- Share its findings with the community
- Stick to the letter of the standard
  - Actual and future
- Welcome and support the introduction of competing solutions
- Provide tools and mechanisms to facilitate the interoperability, configurability, portability and usability
- Make its technology available to colleges and universities for free
- Take the leadership in the development of the new generations of IEC61499 in cooperation with the automation community.

The convergence of Standards

- IEC61499
- IEC 61131
- IEC 61508
- IEC 61504
- IEC 61804-2
- XML
- OPC
Thank you