



## B&R's modular application (mapp) technology sets the bar high for automation programming

The software running industrial machinery hasn't changed much over the past two decades. In the same timeframe, there has been a revolution in computer science and a corresponding boom in computer science graduates.

Despite the constant distribution in consumer electronics, it's been largely status quo in the factories and distribution centers that use computers known as programmable logic and automation controllers. The same can even be said for the icons of automation: industrial robots.

Relay (ladder) logic	Early 20 <sup>th</sup> century
G code	1950s
PLC ladder logic	1970s
C++	1980s
IEC61131-3 PLC languages	1990s

*Much of the control software on today's plant floors has its roots in the 1950s, 1970s and 1980s.*



*Advanced automation technologies will be based on a new generation of software.*

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**The automation skills gap**



Factories and warehouses offer many new career opportunities in system design, integration, operation and maintenance. Yet – at a time when many of the most knowledgeable workers face retirement and relatively few with the needed skills are entering the work force. – these positions are notoriously difficult to fill. One reason for this trend could be that students are being encouraged to follow more glamorous career paths.

Or perhaps it's that programmable control technology is being so rigidly specified by industrial companies that it lacks the necessary sophistication. Initiatives aimed at developing the pertinent skills have already been kicked off by the U.S. Department of Labor and organizations such as the AMT and the PMMI. Still, it must be recognized that the shrinking labor force will never completely fill the widening gap in technical skills between the aging baby boomers and the ambitious millennials.



*In desperate demand: highly skilled, high paid automation workers*

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**It's time to de-skill  
operation & maintenance**



## It's time to de-skill operation & maintenance



*Industrial automation needs to catch up with consumer electronics.*

Industrial automation is in desperate need of de-skilling if it is to keep pace with other technology sectors. PCs, copy machines, mobile devices, cars, smart home thermostats - the most successful tech companies have developed software so sophisticated that users don't require special

skills or training.

The same revolution needs to reach the plant level. But it hasn't so far ist due to issues such as job security, lack of capital investment, offshoring and good old-fashioned resistance to change.

It is also about economies of scale. The industrial control market

represents just 10% of the commercial computing market, so there's less incentive for makers of proprietary industrial controls to reinvest in new proprietary technology. Industrial controls also tend to have much longer service than commercial devices - on the order of then to fifteen years ore more.





## 3 keys to overcoming the skills gap

Developing a new generation of easy-to-use machinery will hinge on 3 catalysts:

1. A move toward higher volume, higher performance and lower cost commercial computing technologies subject to **Moore's Law** and away from dedicated, proprietary industrial platforms
2. Technology providers with sufficient **resources**, but also with sufficient agility and autonomy - who are willing to make the long-term investment in software development
3. Acknowledgement on the part of manufacturing and distribution enterprise that the status quo is unsustainable over the next decade, and the time to embrace change is now



**Keys to overcoming the skills gap:**  
*build on Moore's Law, invest long term in software for the long term, and resolve to embrace change*







## Engineering by far not the only stakeholder

At face value, the skills gap appears to be an engineering issue, so the natural reaction of company officers is to defer to engineering management. In reality, however, there are stakeholders in all corners of the enterprise - each facing their own set of challenges and requirements:

- Human resources struggles to recruit, train and retain highly skilled automation workers
- Operations and procurement can't achieve double-digit increases in productivity with status quo technology
- The same goes for outperforming competitors on a financial success, time to market, sustainability, time to profitability and the flexibility to quickly meet changing consumer demands





## Enter the right technology provider, with the right roadmap(p)

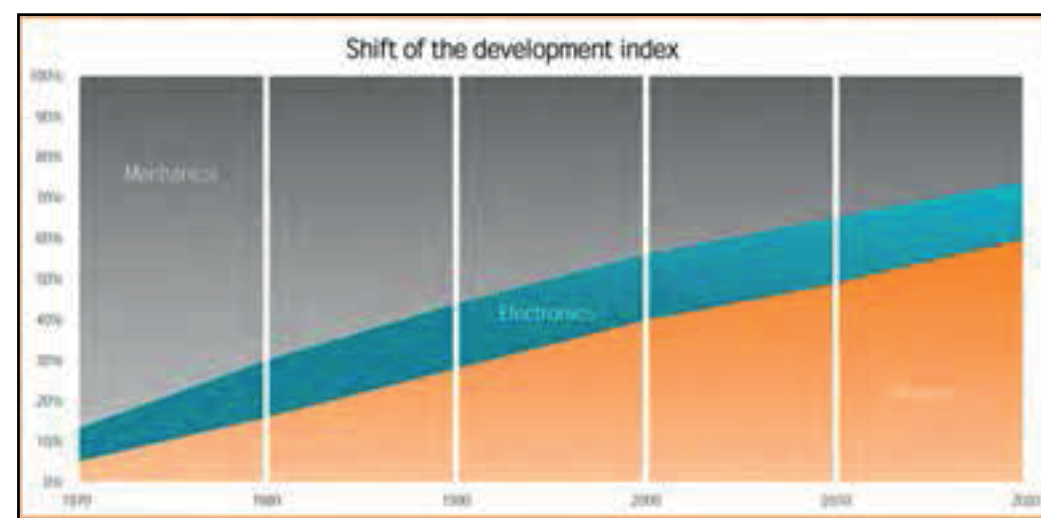
The skills gap has not gone unnoticed by B&R, a privately held automation technology provider trending toward \$1 billion in sales worldwide, double-digit annual sales growth has been aided by Moore's Law as well as its unwavering commitment to R&D investment.

Around 2010, B&R recognized a paradigm shift in its technology base, with more R&D activity now going into software than hardware. At the time, the company made a conscious decision to focus on user experience - to

simplify how machine software is developed, make it simpler to maintain, more modular and reusable, and more graphical.

For the machine builder, this means increased protection of hard-earned intellectual property and a welcome reduction in engineering costs and lead times.

For the user, it means quickly configuring robust software objects rather than tediously rewriting complex code and risking unintended consequences.



*B&R has seen the scales of its own R&D activities tip from hardware and software*



*B&R's 700,000 square foot headquarters.  
The privately held company has over  
2,600 employees operating around the world.*

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**Program less, configure more**



## Program less, configure more

The result, after many man-years of development, is mapp Technology. Short for modular application, mapp represents B&R's strategic investment in its own future viability. It bridges the gap between traditional, sequential software design and intuitive interfaces overlaying advanced software concepts.

mapp embeds powerful software functionality inside readily configured software objects, called mapp links which are based on the IEC 61131-3 standard.

These components communicate via mapp links using a client-server model. Each mapp component provides data that can be queried as needed. This lets you do things like set up an entire energy management system with a few mouse clicks. When you add the mapp energy component to an application, it automatically retrieves the energy data it needs from all the axes via mapp links. Add a new axis, and mapp energy incorporates its energy data automatically. This makes it unbelievably easy to work with machine variants and options.



The bottom line? Vastly reduced programming - replaced by simple configuration of thoroughly tested, high-performance software blocks. Software development time is reduced by an average of two-thirds, and plant-level personell don't need to change code in order to troubleshoot or modify recipes.

*B&R's mapp technology simplifies programming, troubleshooting and recipe changes.*





## The PLC code comfort zone



*With mapp's powerful diagnostic tools, there's no need to access machine code.*

For the past three decades, ladder logic has been the PLC programming comfort zone of North American technicians and controls engineers. The common approach to plant floor troubleshooting has been to go into the machine code and make changes until the problem goes away. More progressive automation managers ask why, if the machine was working yesterday, would the problem be in the control

code? The software didn't change overnight. Something went wrong out on the machine, and changing a dwell time or increasing torque only serves to mask, not fix, the root cause of the problem.

So why do plant maintenance personnel almost invariably begin by accessing the source code of PLC or PAC equipped machinery? Perhaps because - until now - there hasn't been a better way.







*mapp technology appeals to a generation raised on widgets and apps.*

## A painful transition

As the generation raised on PLC ladder logic is begins to retire, the plant floor personnel taking its place will have mastered neither ladder nor computer science.

The stage has been set for a painful transition from old school to no school on the plant floor. At the same time, manufacturers increased machine functionalities are required for manufacturers competing in a global marketplace are demanding new and increased machine functionalities.

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**mapp Technology eases the transition**



## mapp Technology smoothes the transition



*mapp technology simplifies every aspect of machine control, from development to diagnostics.*

These are two of the real-world challenges mapp technology was created to solve.

Frontline experience of control engineers, has confirmed how easy mapp makes it to develop applications, change parameters and troubleshoot machinery.

mapp's mantra is to configure more and program less. A notion that holds true for machine builders and end users alike. With mapp, there's no need to delve into the labyrinth of PLC code. Diagnostics can be handled remotely with simple connectivity tools like onboard web servers and VNC connections.





## It starts with motion: mapp mechatronic components

It's not hard to find a controls supplier that offers function blocks for motion control. Still, executing a typical synchronized multi-axis application requires ten, eleven, twelve or even fifteen function blocks.

mapp technology reduces that to one component for single-axis movements and other for multi-axis control. More than 50 different

functions are covered by a single mapp component. The machine designer simply enters the parameters and the software figures it out. This is a sea change in motion programming, but it's still only the tip of the iceberg when it comes to mapp technology. As much as possible the effort involved in providing basic functionalities - an effort that is normally duplicated over and over with each new machine.

MpAxisBasic	
MpLink	Active
Enable	Error
ErrorReset	StatusID
Parameters	UpdateDone
Update	
Axis	
	Position
	Velocity
Power	PowerOn
Home	IsHomed
MoveVelocity	InVelocity
MoveAbsolute	InPosition
MoveAdditive	MoveActive
Stop	Stopped
	Info

***With mapp Technology, a single mapp component replaces a dozen motion control function blocks.***

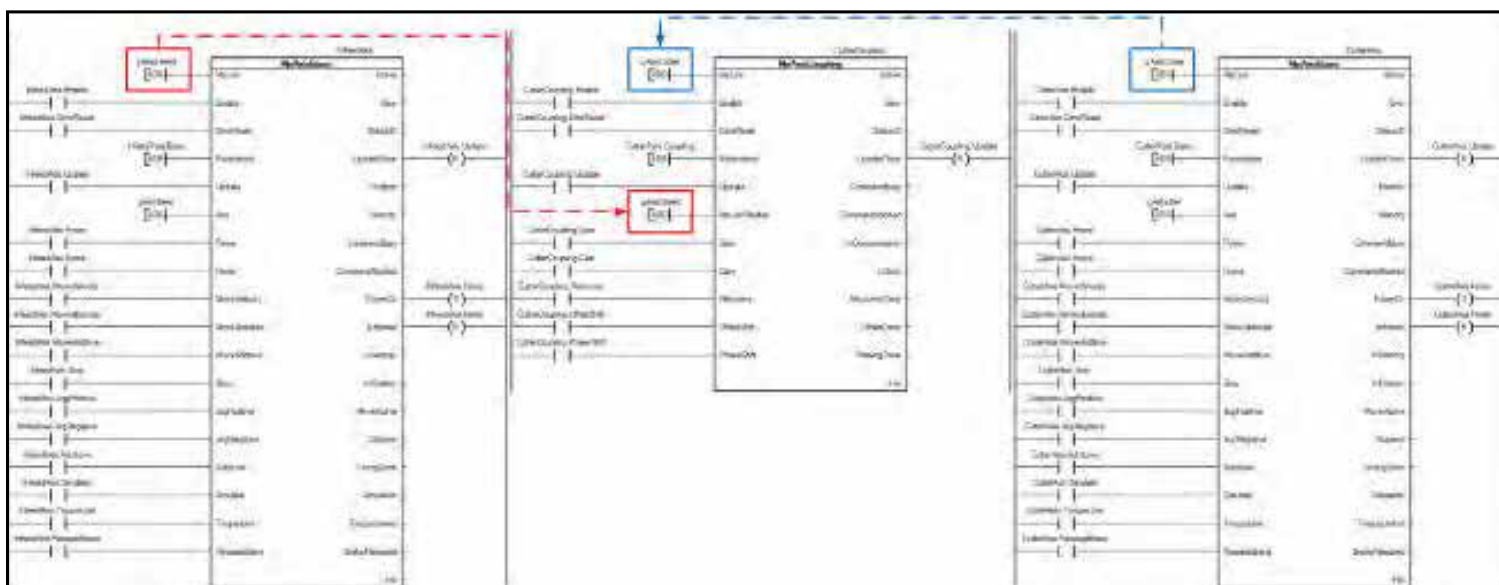




## mapp axis mapp mechatronic components, continued

The mapp axis component provides single-axis or multi-axis synchronized motion through single components instead of the dozen or more user-defined function blocks you may be used to.

mapp axis has 25 built-in functions, including gearing, camming, offset, phase handling, recovery, error and recipe handling.

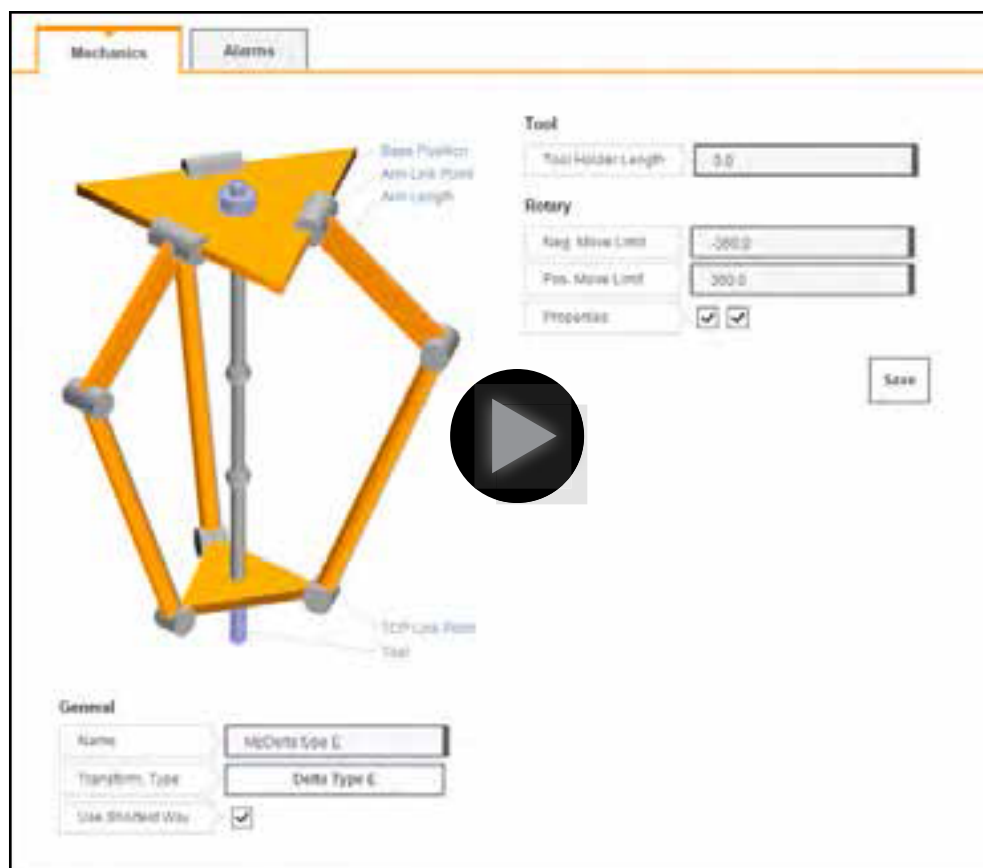






mapp robotics

## mapp mechatronic components, continued



The mapp robotics components offer a simple interface to control all types of robot kinematics.

Access to the mechanical configuration via a web browser makes it easy to configure popular robot types in a matter of minutes.

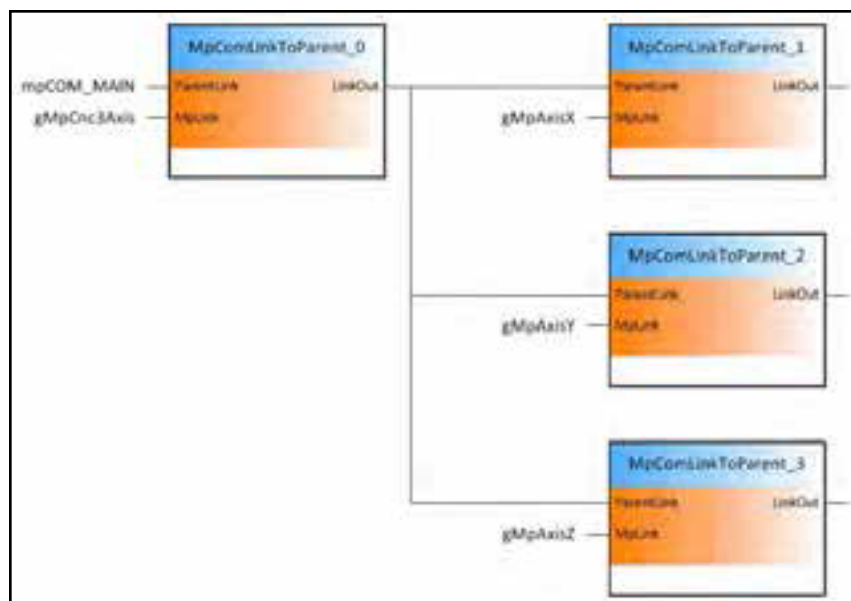
Thanks to B&R's integrated robotic solution and mapp components, complex communication with external robotic systems and additional external hardware are now obsolete.





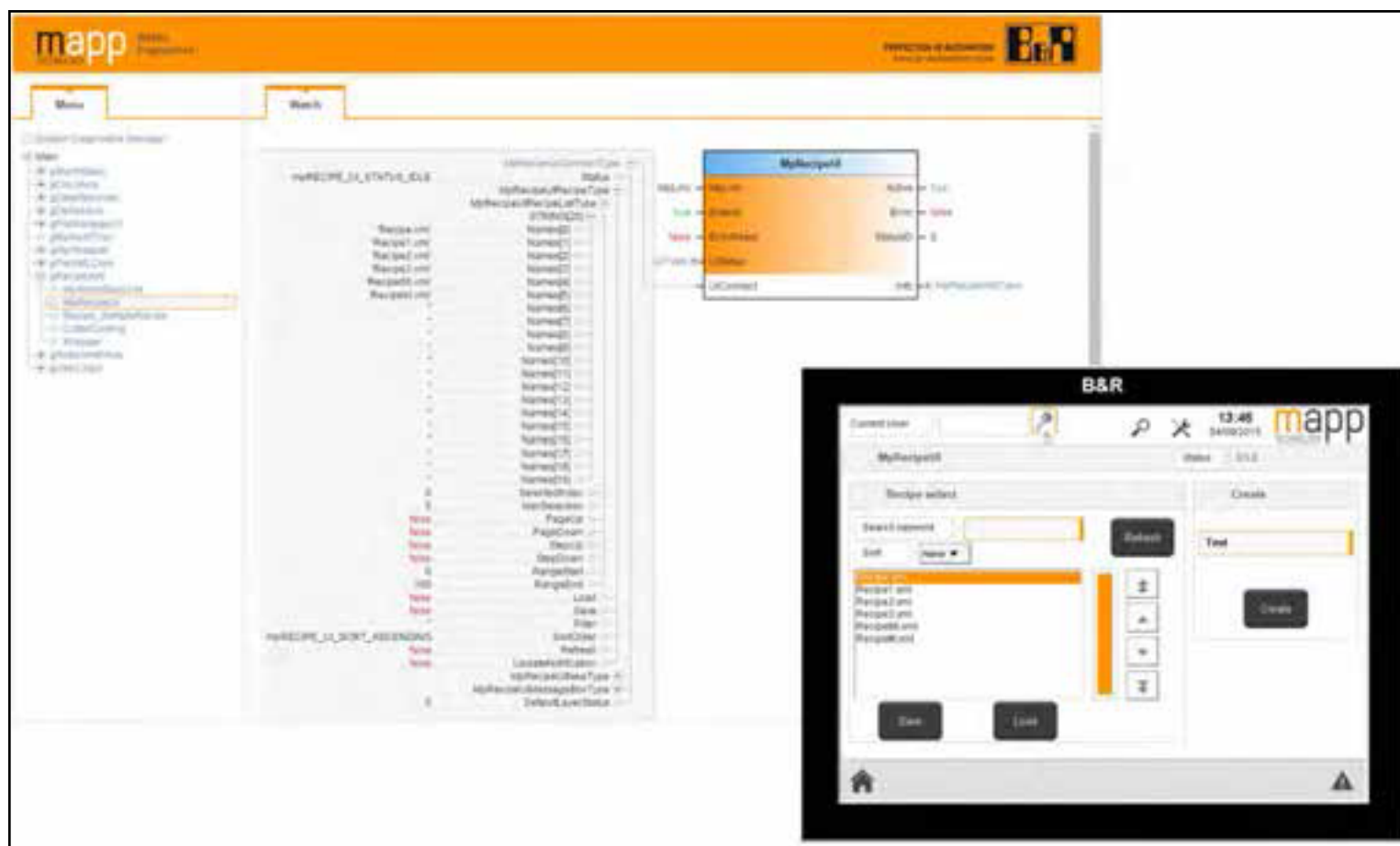
## mapp CNC mapp mechatronic components, continued

The mapp CNC component provides a ready-to-use interface to control your CNC machine using standard G code. Functionalities include single-step, interrupt, continue and restart the program





## Enter a new comfort zone, mapp infrastructure component



Controls engineers face many tedious, repetitive programming tasks that are essential to machine operation but do not add value or help to differentiate the machine.

Recipe handling, user management and audit trails are time hogs in the development of every new machine. B&R's mapp components provide diagnostic information via a web browser - allowing you to access and diagnose machine control down to the function block level without dedicated software, special training or access to the source code.





## mapp alarm handling

# mapp infrastructure components, continued

Each mapp component comes with preset alarms, and user-defined alarms can be added as needed.

All alarms are described in plain English and are automatically mapped for viewing from the HMI.

Name	Value	Unit	Description
RoboArm6Axis			
Anthropomorphic 6-Axis robot	Mechanics type A		Anthropomorphic 6-Axis robot configuration
Robot name	COMAU Racer 7-1.4		Unique name for the robot throughout the project
Transformation settings			Transformation settings of robot
Mechanics			Mechanical description of the robot
Joint			Joint description of the robot
Home sequence	All together		Defines the order in which the axes should be homed
Workspace monitoring			Workspace monitoring configuration
Alarms	Basic		
mapp Alarms			
Alarm List			
Alarm 0: System error on robot arm			
Alarm 1: Initialization failed			
Alarm 2: Robot reached end of workspace			
Alarm 3: Robot program violates workspace (+ ErrorCode as add.info)			
Alarm 4: Syntax errors in robot program (+ ErrorCode as add.info)			
Alarm 5: Robot program not found			
Alarm 6: Path velocity not defined for a block movement in robot program			
User Alarms	No		







mapp file

## mapp infrastructure components, continued



mapp file handling in Windows Explorer makes it simple, for example, to download a new machine configuration from a USB stick.





## mapp data

## mapp infrastructure components, continued

With the mapp data component, motor positions might be recorded and the data mapped to a spreadsheet and plotted to a chart. Data can be sampled in intervals ranging from milliseconds to days- ideal for condition monitoring.





## mapp user mapp infrastructure components, continued



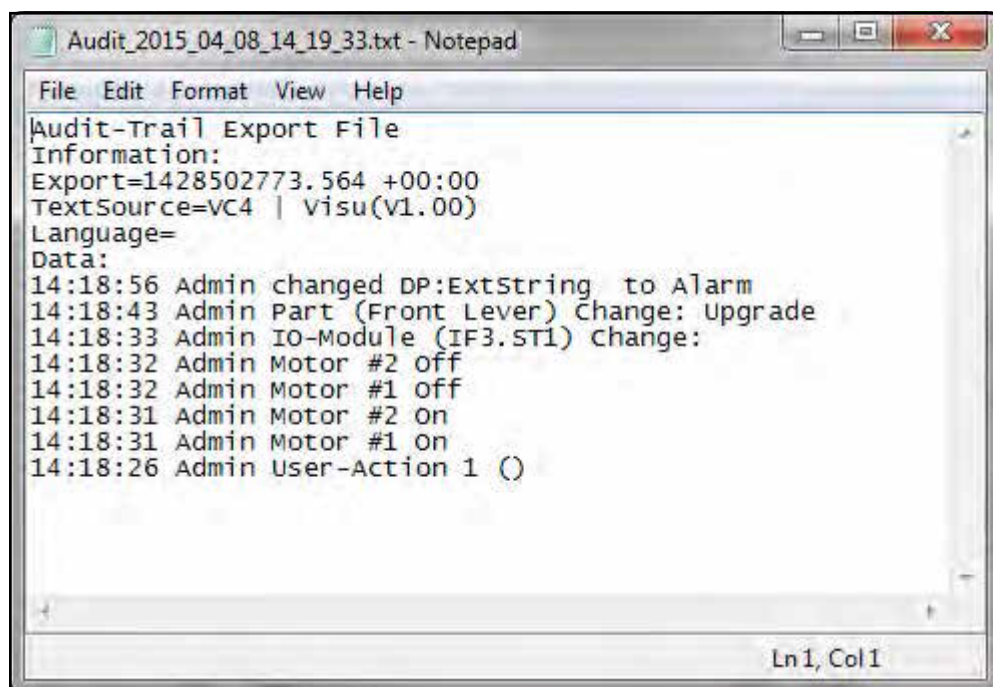
Login, logout, user rights, user groups, password handling – the mapp user component offers extensive capabilities for handling all of these advanced functionalities.





## mapp audit

mapp audit is an advanced mapp component originally designed for implementing CFR 21 Part 11, but equally well suited to any kind of event logging requirement.



```
Audit_2015_04_08_14_19_33.txt - Notepad
File Edit Format View Help
Audit-Traill Export File
Information:
Export=1428502773.564 +00:00
TextSource=VC4 | Visu(V1.00)
Language=
Data:
14:18:56 Admin changed DP:ExtString to Alarm
14:18:43 Admin Part (Front Lever) Change: Upgrade
14:18:33 Admin IO-Module (IF3.ST1) Change:
14:18:32 Admin Motor #2 Off
14:18:32 Admin Motor #1 Off
14:18:31 Admin Motor #2 On
14:18:31 Admin Motor #1 On
14:18:26 Admin User-Action 1 ()
```







## mapp industry component: PackML made easy

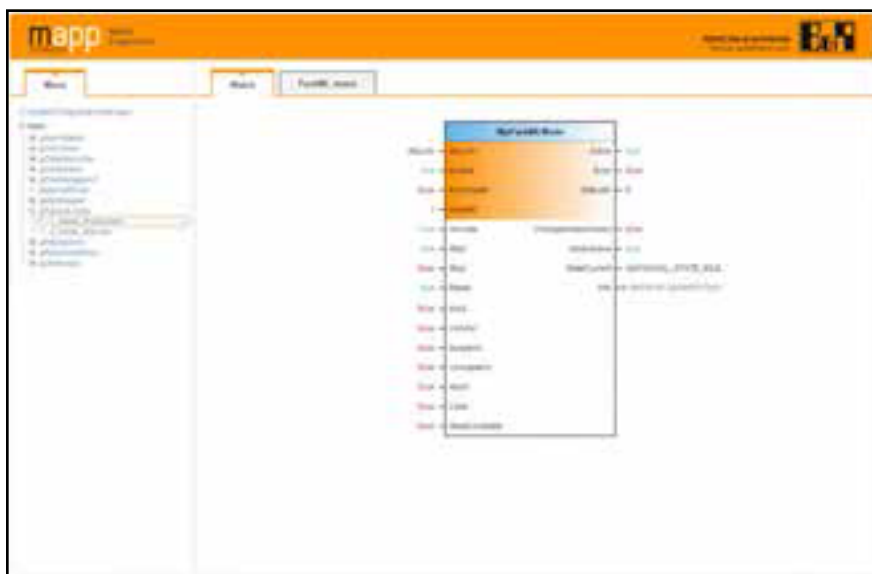
mapp industry components provide a fast, easy way to implement the ISA TR88.00.02 standard (also known as OMAC PackML) for defining machine states, modes and tag naming conventions.

The mapp PackML component makes it easier to implement, starting with the ready-to-use PackML screen and simply removing unneeded states.

A single component configures the entire state

machine, including multiple instances, ideal for integrating elements of any production line.

What's more, the current and cumulative time-in-state can be viewed from any web browser.





## The future of automation software is here today

Never before has a technology provider taken such a comprehensive approach to automation software. Never before has automation software been so powerful and easy to use.

Of the three catalysts described on page 4 of this white paper, B&R has the first two covered - a control platform driven by Moore's Law and the resources and determination to invest in a better approach to automation.

The third catalyst is up to to the readers of this white paper. Those who embrace a strategy of change - away from the unsustainable legacy systems toward a new generation of automation technology - will benefit from a competitive edge now and long into the future.

To learn more about B&R's mapp Technology, visit [www.br-automation.com/mapp](http://www.br-automation.com/mapp)



*As this lighthearted video depicts, mapp technology rewards those who are willing to embrace change with significant increases in productivity.*

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