THE FUTURE OF PRODUCT LIFECYCLE MANAGEMENT

After 40 Years, Where Are We And What's Next?

Abstract

A critical review of the status of Legacy PLM and alternatives becoming available

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Chapel Hill, NC

July 2026 (R5)

Author Statement

This work has been spurred by a career-long involvement in PDM/PLM and a desire to see genuinely innovative solutions succeed the legacy systems that companies are using today. This is an independent, self-funded effort.

Key Take-Aways

- It's time to for industrial companies to question their commitment to Legacy PLM systems in the light of dramatically increased product complexity.
- Legacy PLM systems are limited to managing MCAD data, mechanical part BoMs, and change processes during the design phase of the product lifecycle.
- Legacy PLM systems have been acting as defensive moats around their owners' MCAD systems since the 1980s when products were dominated by mechanical parts.
- Over the same time product complexity has increased dramatically with today's products being dominated by electrical systems, electronics, embedded software, wireless connectivity, and cloud services.
- In the last few years new post-PLM systems have become available that recognize current product complexity and provide innovative capabilities to better support the lifecycle of today's products.
- Industrial companies using Legacy PLM systems should start evaluating the newer alternatives available.

Introduction

Why this report and why now? A simple and honest answer would be that it's time to draw back the curtain on Legacy PLM and reveal how it has been failing to deliver for decades.

Practicing engineers, struggling daily with unreliable workarounds, know this well. But for many PLM practitioners, this will be a difficult message to absorb. This is especially the case in the face of relentless gaslighting from the Legacy PLM vendors, all of whom are claiming to have complete solutions. And compounded by a new Gartner MQ putting the Big 3 Legacy PLM vendors in the Leader's Quadrant. In reality, these vendors with their MCAD and mechanical part centric architectures are Niche Players – managing only part of the product during only part of the lifecycle.

What's the alternative? The answer, as this report will explore, is that there are many new solutions available, all proven in use in demanding customer environments. They all address the fundamental constraint of Legacy PLM in that they don't treat MCAD as the center of engineering processes.

Why are these new solutions not better known? Perhaps because they lack a category name to rally behind. For most, PLM is a toxic term that they don't wish to be associated with. But creating and popularizing a new term is expensive and beyond the reach of these companies. And, as we saw, Gartner is not helping by continuing to promote legacy solutions.

If you care about PLM, either as a provider or a user, read this report. And then take action. The status quo is no longer acceptable.

Just Another Day in the Office

For product development engineers, a day at the office consists largely of heads-down work in whichever tool supports their domain of expertise (mechanical, electronics, software, etc.). Most of these tools will have data management environments to ensure safe storage and ensure version control.

An important part of their day will involve collaborating with colleagues in other areas of the company to ensure that requirements are met and changes are managed. As they are using different systems, they must use basic capabilities to share information, for example, PDF documents, screenshots, spreadsheets, etc. These will usually be transmitted as attachments to email messages. Discussions may also take place via email or other tools like Slack.

When designs are ready for release, they will be shared with downstream users in functions like manufacturing planning and procurement. Again, they must use basic capabilities to share information transmitted via email messages.

This is how business has been done for decades. Despite increases in the complexity of products being developed and advances in the tools being used to develop them, the environment for managing product information, supporting collaboration, and releasing it to downstream users has hardly changed in decades. The results are everywhere: tens of thousands of hours lost every day searching for and recreating information; poor collaboration across technical disciplines dragging out development time; and broken downstream communications increasing costs and delaying product launches.

It wasn't meant to be like this. PLM systems, a term coined 25 years ago to describe an even older technology, were meant to address this. And if you listen to the vendors of the Big 3 Legacy PLM systems today, you will think they have. However, the reality is somewhat different, as this paper will explore. But the potential for change is already with us, with many new solutions now emerging to address part or all of the challenge of managing the complex product engineering ecosystem.

When Did This All Start?

The Legacy PLM vendors' market dominance dates to the 1980s. It's important to understand how we got here as it will uncover the flawed logic of holding on to Legacy PLM, even as it undermines engineering processes and threatens businesses.

A quick summary of the 40-year history of PLM can be found in Appendix 1.

What Have You Been Told About Legacy PLM?

If you work with PLM, you've probably been told many things in the past and continue to hear them to this day. Here are some of the main ones:

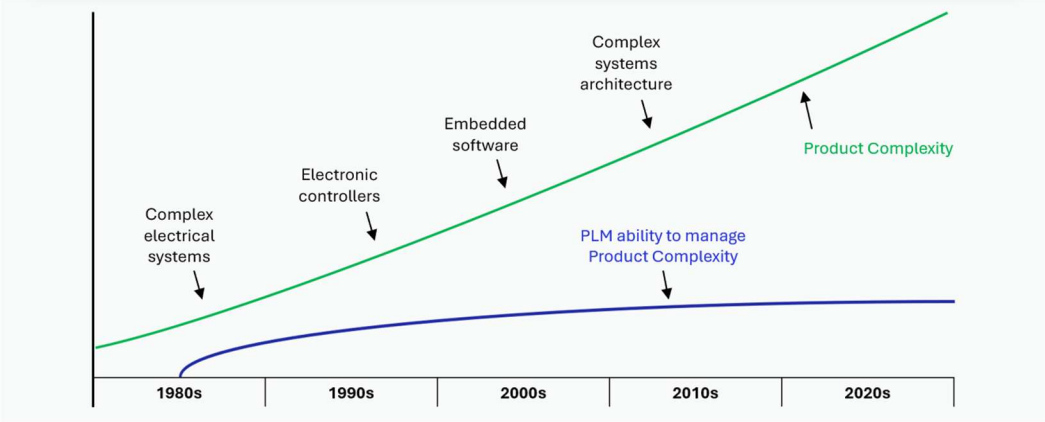
- PLM gathers all product information using digital threads into a "single source of truth"
- PLM connects all users of product information, allowing them to collaborate
- PLM eliminates the need for spreadsheets, Slack, and email
- PLM plus AI will reduce time to market, improve sustainability, accelerate innovation, reduce costs, etc.

If only it were all true

What's Wrong with Legacy PLM?

Legacy PLM is characterized by deep MCAD integration and workflows optimized for mechanical parts. Perfect for the products and factories of the 80s-90s when it was conceived.

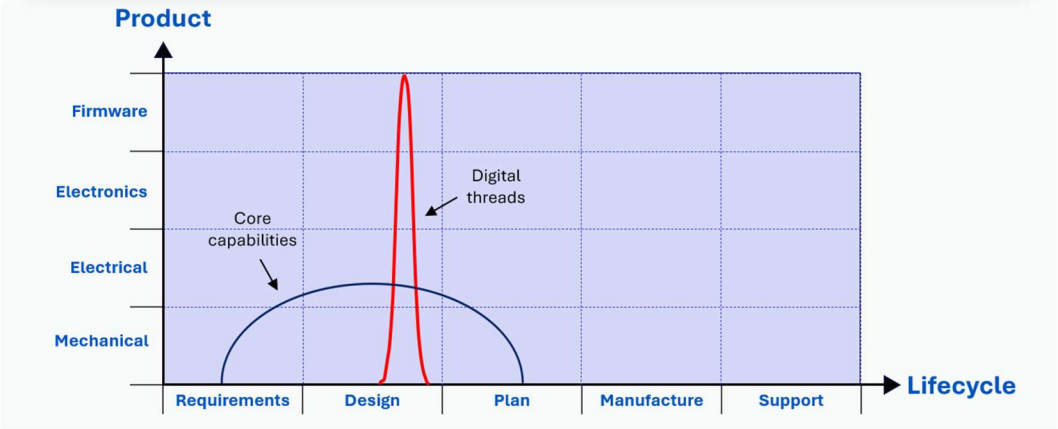
But since then, product complexity has increased dramatically and has impacted every industry sector.



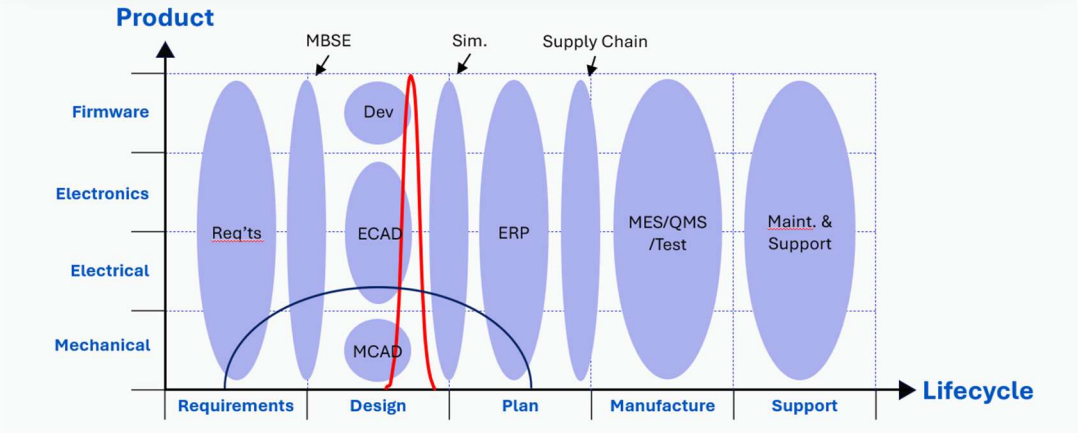
Aerospace and automotive are obvious examples but even consumer products can have high degrees of complexity. For example, a connected electric toothbrush, complete with variable speed brushing action, programmable electronic controller, pressure sensors, wireless battery charging, Bluetooth app and cloud connection.

Legacy PLM, focused on managing MCAD files and associated mechanical parts, is completely unable on its own to manage collaborative, cross-discipline development process or to synchronize part release, procurement, or manufacturing of even a moderately complex product like a connected toothbrush.

The reality is that Legacy PLM covers only a subset of the product and its lifecycle. Even when digital thread connections are added, coverage is only in the range of 10-15%.



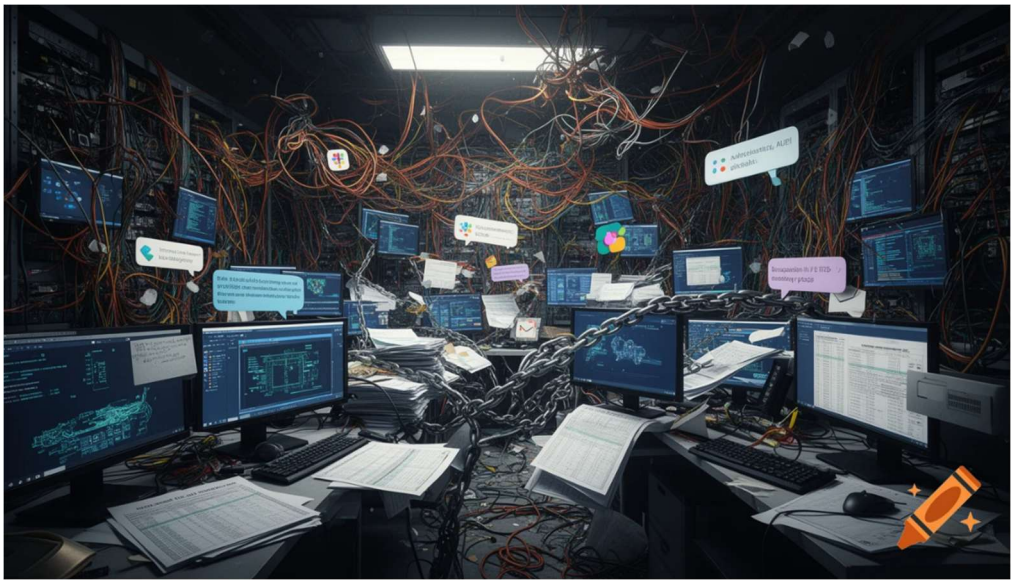
This lack of coverage becomes even more stark when we add in all the other systems that are supporting the lifecycle of a complex product. Legacy PLM is not connected to most of them, leaving huge gaps to be filled by spreadsheets, email, Slack messages, and reliance on tribal knowledge which can walk out the door at any time.



Companies that want an integrated ecosystem for complex products must build it themselves. But the results are usually complex, fragile, and beyond the means of all but the biggest.

This limited scope makes Legacy PLM a poor environment for AI-enablement, either using LLMs or Agents. This is worsened by the fact that Legacy PLM systems mostly contain transactional information with limited context explaining why actions were taken. Tests have shown that there is little inside Legacy PLM systems that can't be found using their integrated search capabilities. This renders the argument that Legacy PLM plus AI is a game-changer as false.

Here we are in 2026. Today's engineering ecosystem - broken processes built on legacy technology with no possibility of future enhancement from AI or anything else.



It's time to leave Legacy PLM behind and replace it with new solutions that address the needs of all engineers and can fully exploit the power of AI-enablement.

What's Next: The Future Platform for Hardware Engineering

What kind of system do engineers responsible for developing, manufacturing, and supporting complex, system-centric products need? This section describes the characteristics of a Future Platform for Hardware Engineering (FPHE) as a successor to Legacy PLM and provides a reference model to compare systems already on the market.

Whereas the defining characteristic of Legacy PLM is its **MCAD-centricity**, the FPHE provides user access to information about the **complete product** through the **full lifecycle**. And whereas Legacy PLM treats **design as the origin stage** in the lifecycle, the FPHE treats **all lifecycle stages equally**.

These two differences have a fundamental impact on the impact and value of the FPHE compared to a Legacy PLM system. All users concerned with any aspect of the product lifecycle from Requirements through to Maintenance & Support now have a single platform to go to find any product information required and to explore relationships between items created in different systems. This opens the door to improved support for cross-discipline collaboration and through life processes such as verification & validation, and digital twin models of in-service products. Critically, **the selection of the best platform will no longer be constrained by the MCAD system in use**.

Is A Platform the Best Approach?

There has been active debate recently on the best architectural approach for the successor to Legacy PLM. Some of the points discussed are listed below:

1. A platform provides the information access and context needed to enable successful use of AI agents to find information and automate processes.
2. Concerns have been raised about a platform being "another Monolith". This seems to be more of an emotional response than a technical one as most large businesses already have at least one monolithic system in place – ERP.
3. An alternative proposed is a series of flexible modules, each focused on performing specific tasks. But this does not appear to be much of an advance over today where domain-specific tools already have some process and data management capabilities. The challenge is that these systems are all silos and lack the overview of the entire product and its lifecycle that a single platform could provide.
4. A third alternative proposed is a network of interacting AI tools. This approach, while an attractive way of solving individual problems, lacks the persistence of storage and consistency of process that a platform can provide.
5. A fourth alternative discussed is retaining Legacy PLM. Tactically this makes sense for a period of time, and this is discussed further in a later section. However, strategically this option makes no sense. Legacy PLM vendors have had 25 years to invest in their offerings to keep abreast of the growing complexity of products and have failed to do so. It's unlikely that will change now.

Do We Need a New Name Category Name?

Do we need a new name like FPHE? Isn't it good enough to keep using the term PLM? Or maybe a variant like PLM2, or PLM+, or PLM-X?

Using a familiar term always gets the same response. People have long ago decided what they think about PLM and it's not possible to convince them that something new is happening. But use a new term and most people will be curious, open to new ideas and willing to learn. The term used is less important than the fact that there is one.

The FPHE is a fundamental advance over PLM and needs a distinct identity. It's as far from PLM as ERP is from MRP.

Do we even need a category name? The emerging vendors could continue to market their solutions under various guises. That would allow them to make their own markets but likely at high cost as they must continually educate prospects on who they are and what they do. The use of a common category name allows them all to build on each other's marketing efforts and focus on the distinct value their solution can bring.

But there is a risk that, unless the term is widely referenced by solution vendors and accepted by others, it will never surface in discussion and will be forgotten.

What Does the FPHE Do For the User?

When analyzing the emerging candidates for FPHE, the most important criterion is "the jobs that get done by the platform" that improve the effectiveness of the engineers using it. These "jobs" are implemented in the **applications** that are supported by the platform. **Applications are the fundamental source** of value from the platform in that they can allow engineers to work more quickly and with fewer errors, both helping to reduce costs. More details on FPHE benefits can be found later.

Some of the most typical applications are described here but many more will emerge and evolve in the future. Some are also seen in Legacy PLM, but with the important distinction that, whereas Legacy PLM is focused on mechanical design items, the **FPHE has access to complete information about the product and its full lifecycle**.

Design Management

Manages the lifecycle status, including review and approval, of product items during the design phase of the lifecycle prior to release. For example, parts, drawings, CAD models, system models, requirements, etc.

BOM and Change Management

Manages the creation and maintenance of various types of BOM through the product lifecycle and the management of change of varying degrees of complexity to items and their BOMs.

Requirements Management

Manages the development, review, and approval of product requirements, the design items that satisfy them, and the tests that verify and validate them.

Systems Engineering

Manages the relationships between system models (SysML) and the product items that implement them.

Lifecycle Analytics

Manages, reports, and supports the optimization of lifecycle product characteristics such as cost and environmental impact.

Digital Twin Builder

Leverages information throughout the lifecycle of a product to create various types of Digital Twins by integrating managed models with live or simulated device data feeds.

Verification & Validation

Links simulation and test results back to requirements to prove they've been met.

Inventory Sync.

Synchronizes data between MES and ERP to ensure accurate, real-time inventory information across multiple applications.

Underlying FPHE Capabilities

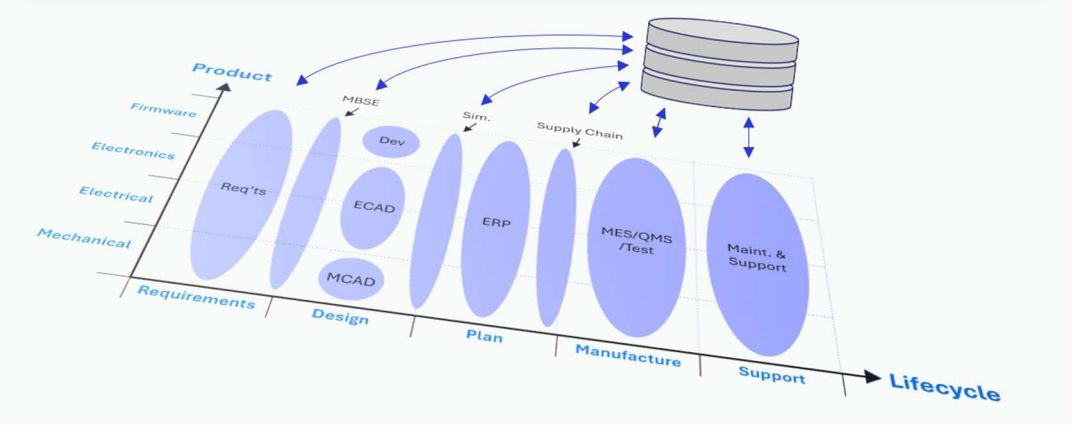
To implement these applications, the FPHE must embody many underlying capabilities. The most important capabilities are described here.

1. Full Product and Lifecycle Information Access

The FPHE connects engineers working in **every discipline** (electrical, electronics, software, wireless, etc.), **every function** (development, test, procurement, manufacturing, service, etc.).

The FPHE also connects **every system** they use (MCAD, ECAD, simulation, coding tools, MBSE, MES, ERP, etc.). These connections are integral to the platform itself, built and maintained by the platform vendor and not ad hoc additions built by consultants.

A structured ontology normalizes entities, attributes, relationships and operational semantics across systems. Information items and key attributes are replicated within the platform and synchronized with the source to reflect updates



2. Item Management

At the heart of the FPHE is the management of all types of product information items (parts, models, requirements, drawings, etc.). These can be either imported from connected systems or natively created in the platform.

Management of items includes the following:

- Management of user access privileges.
- Synchronization of changes with the originating system.
- Presentation of information in a viewable format and, ideally, subject to markup.

3. Relationships Between Managed Items

The FPHE maintains relationships between managed items in the platform, even if these items originated from different connected systems. Relationships may be imported from external systems or created in the platform itself.

Relationships should be typed according to their purpose and carry meaningful attributes. Relationships and their corresponding information items should be displayed in both graphical and tabular fashion.

Relationships are used for such functions as to guide users to related information (for example, CAD model of a part, parts in an assembly, requirement satisfied by a test).

*4. Data Transfer Workflows**

The FPHE uses manually-triggered or event-driven workflows to manage the transfer of information between systems, for example the transfer of a Bill of Materials (BoM) to an ERP system. All transfers are recorded, allowing bidirectional traceability of the flow of information between systems.

Because of the increased scope of the FPHE compared with Legacy PLM, any information can be moved between any connected system involved with the product lifecycle.

A critical test for this capability should be "Do we still need spreadsheets to communicate between systems?"

**Note that, although this capability bears a resemblance to the term digital thread, to avoid confusion, the term digital thread is not used here as it has no firm definition*.

5. User Communications

The FPHE supports direct communications between users in several forms – messages, markups, and file transfers. The communications mechanism will link directly to managed items in the FPHE, providing context and traceability.

A critical test for this capability should be "Do we still need Slack, email, and spreadsheets to communicate between users?"

6. User Applications

Beyond its basic functions to manage product information and relationships, the FPHE enables applications to perform specialized cross-discipline functions, as discussed earlier. Applications may be:

- Integral functions of the platform
- User-built extensions to the platform created and maintained by a low-code/no-code application builder
- External tools which use APIs to access and/or update information in the platform

7. Open to AI

The FPHE architecture is AI-ready allowing managed agent access to governed data.

AI is used to continuously support engineers by automating repetitive processes. For example, BOM configuration and change management is enriched with the knowledge of interdependencies with other parts/activities/requirements allowing it to be automated and agent-driven, with engineers performing final review.

Other repetitive processes helped by AI include verifying designs against requirements, conducting manufacturing feasibility reviews, placing part orders, creating user and service manuals, investigating service reports, etc.

AI helps team members communicate as it acts as an “interpreter” between, for example, hardware and software engineers. All user interactions go through the FPHE (no more email or Slack messages), allowing all decisions to be recorded, and all information to be quickly accessed (no more Excel, PDFs, STEP files, etc.).

FPHE - Benefits

The potential for significant benefits from the FPHE is high.

Many time, cost, and quality related benefits have already been claimed by Legacy PLM, but most have never been achieved. The small benefits that might accrue from using Legacy PLM get lost in broken processes relying on spreadsheets, email, and Slack messages.

Significant benefits can accrue from the use of an FPHE by connecting all creators and users of product information across all disciplines and through all stages of the product lifecycle into the same, consistent working environment.

A number of benefits have been identified and are described here.

Engineering & Design

- Improved time to market:
    - Improved coordination of activities across disciplines to meet requirements, avoiding unnecessary redesign, prototype manufacture, and testing
    - Reuse of existing parts or select supplier parts, avoiding unnecessary redesign, new tooling and manufacturing processes, service planning, etc.
- Increased margins:
    - Elimination of avoidable labor and capital spending
- Improved customer satisfaction (retention rate):
    - Reducing known product quality, usability and/or reliability issues
- Increased revenues (without adding headcount):
    - Ensuring products are aligned with customer or market needs and are competitive

Sourcing

- Improved sourcing specialist productivity:
    - Direct access to required information allowing sourcing specialists to minimize time required to do their job
- Reduced sourcing delays:
    - New and updated sourcing agreements can be put in place more quickly, speeding up procurement and avoiding delays
- Improved sourcing decisions using accurate information, leading to:
    - Improved margins due to managed supplier costs
    - Reliable quality and supply of sourced items
    - Reduced exposure to product compliance issues and supply disruption
- Increased revenue through improved customer satisfaction and competitiveness

Maintenance & Support

- Improved customer productivity:
    - Improved access to service manuals allows customers to minimize asset maintenance and repair time
- Improved internal productivity:
    - Improved access to customer, service, and product information minimizes time for customer support
- Optimized use of internal resources:
    - Improved productivity reduces number of required field and internal technicians and support centers

- Improved customer satisfaction and loyalty:
    - Minimized asset downtime for increased customer revenue generating capability

Who Will Build the FPHE?

Legacy PLM vendors stuck in the 1990s and 2000s mindset of MCAD centricity will likely default to defending their current products rather than evolving their thinking and actions to the needs of complex system-centric products. The business pressure to leverage past investments and layer additional capabilities onto legacy systems will be very high. The need to re-train the workforce and rework go-to-market programs will also present significant barriers. These vendors are not considered further in this report.

Vendors established with the explicit goal of supporting complex system-centric products are likely to be the winners in the future. Several vendors have already released products that bear some similarity to the FPHE vision and are gaining market traction. This report will refer to them as the FPHE Visionaries:

Company	**Website**	**Country of Origin***	**Year Est.***
Cognyx	www.cognyx.io	France	2024
Dalus	dalus.io	USA	2024
EXP Software	explore.de/en	Germany	2023
Flow Engineering	www.flowengineering.com	USA	2018
Intercax	intercax.com	USA	2007
Makersite	makersite.io	Germany	2018
SPREAD	www.spread.ai	Germany	2019
Violet Labs	www.violetlabs.com	USA	2022

*Data retrieved from LinkedIn company profiles during June 2026.

How Do They Compare?

This section provides a brief description of each of the FPHE Visionaries' solutions listed above and comparisons using the reference model already described.

The descriptions and analysis are based on readily available public information. The FPHE Visionaries did not participate in the writing of this report but were invited to provide factual corrections prior to publication.

Cognyx

Uses AI to assemble BOMs from part information from ERP and PLM systems. Supports MBSE-based simulation and lifecycle constraint optimization.

Dalus

A collaborative engineering platform based on the SysML v2 specification which models system architecture, requirements, analysis and verification.

EXP Software

A digital thread platform built on a relational graph foundation enabling the generation of dynamic digital twins. Connects data from multiple sources and supports digital thread navigation, collaboration, traceability, and impact analysis.

Flow Engineering

Builds a systems graph which holds the entire program as one connected model. Includes requirements, design decisions, interfaces, budgets, tests, and compliance evidence. Evaluates change impact.

Intercax

MBSE-focused platform that enables engineering teams to collaboratively develop and manage digital threads by federating information from modeling and simulation tools, enterprise applications, and data repositories.

Makersite

Builds digital twin by mapping and enhancing product data with materials, substances, and supply chain information. Users can analyze and optimize sustainability, compliance, and cost.

SPREAD

Comprehensive platform integrates data from multiple tools, manages relationships, and provides a single source of truth for engineering teams. Evaluates change impact.

Violet Labs

Platform which creates comprehensive product models by sync'ing information from over 70 systems across disciplines and through the product lifecycle. Integrates with MBSE and supports BOM and change management.

Applications Comparison

A comparison of the applications provided in each of the FPHE Visionaries platforms is shown in the table below. This is a high-level comparison and indicates only if an application defined in the reference model is present or not. No scoring is included and it's left to the reader to do further research and make their own judgements.

Capabilities	Cognyx	Dalus	EXP Software	Flow Engineering	Intercax	Makersite	SPREAD	Violet Labs
Design Management					✓	✓	✓	✓
BOM Management	✓		✓	✓		✓	✓	✓
Change Management			✓	✓			✓	✓
Requirements Management		✓		✓	✓		✓	✓
Systems Engineering (MBSE)	✓	✓		✓	✓		✓	✓
Lifecycle Analytics	✓				✓	✓		
Digital Twin Builder			✓			✓		
Verification & Validation		✓		✓			✓	✓
Inventory Sync.								✓

Applications Comparison

Capabilities Comparison

A comparison of the capabilities in each of the FPHE Visionaries platforms is shown on the next page. This is a high-level comparison and indicates only if a capability defined in the reference model is present or not. No scoring is included and it's left to the reader to do further research and make their own judgements. More detailed comparisons can be found in Appendix 2.

Comparison Conclusions

It's apparent from the review that each FPHE Visionary is taking a different approach to the market in terms of the applications they are providing on their platforms. But what's clear is that they have a lot in common with each other and all are in positions to grow their application coverage over time.

Capabilities	Cognyx	Dalus	EXP Software	Flow Engineering	Intercax	Makersite	SPREAD	Violet Labs
Full Product and Lifecycle Information Access	✓	✓	✓	✓	✓	✓	✓	✓
Item Management		✓						✓
Relationships Between Managed Items	✓	✓	✓	✓	✓	✓	✓	✓
Data Transfer Workflows			✓		✓			✓
User Communications	✓	✓						✓
User Applications	✓	✓	✓	✓	✓	✓	✓	✓
Open to AI	✓	✓	✓	✓			✓	✓

Capabilities Comparison

Of those analyzed, **Violet Labs** comes closest to the FPHE vision, providing a platform for multiple applications and AI agents with an impressive collection of tool and system connectors, focus on ingesting and synching information, and support for systems engineering including requirements validation.

SPREAD and **Flow Engineering** are also focused on building platforms with support for multiple applications. **Cognyx** is focusing their solution on building the BOM, while **Dalus** and **Intercax** are leaning into support for systems engineering. Both **EXP** and **Makersite** are focused on building digital thread platforms enabling digital twins with support for through-life analytics and optimization.

The application focus is important not just from the point to view of platform ROI but also in terms of the customers initially attracted. Although some applications may have stronger ROIs than others, the market sizes will differ, and the FPHE Visionaries should bear this in mind.

A focus on platform first, highlighting broad connectivity across disciplines and through-life is always going to attract the largest audience. BOM management may also attract a large audience however the topic is so complex that many may not choose to start their transition to a new platform there. Support for MBSE is powerful but its use is limited to the most complex areas of engineering and hence the audience it can attract is low. The same applies to digital twins and their use, while growing, is limited to complex scenarios often involving long-life capital projects.

What's also clear is how often the FPHE Visionaries are treating Legacy PLM as a source of information to populate their platforms. This makes perfect sense in the short term as Legacy PLM systems should offer access to at least some of the information required to define a complete product model but much of the information will come from other systems. But long term they may need to become fully independent of Legacy PLM in order to provide their customers with an additional incentive to fully migrate.

Although none of FPHE Visionaries appears to have fully met the requirements of the FPHE yet, they are all very close and could fill the gaps quickly. In the meantime, they have all carved niches for themselves and are *quietly* building their market presence. More on this later.

Is There a Continuing Role for Legacy PLM?

Legacy PLM systems are not going to disappear overnight and may still be around a decade or more from now. This can be explained in four ways:

1. The need to maintain Legacy PLM as an MCAD vault (PDM functionality).
2. The need to continue using Legacy PLM to manage product configurations, especially when it contains proprietary rules, until such time as these can be replicated in the FPHE.
3. The pace of change dictates that not all products or processes can immediately be transferred to an FPHE system.
4. Even if there is a commitment to move away from Legacy PLM, it may still be pragmatic to maintain it until the end of life of certain products.

Recommendations for Industrial Users of Legacy PLM Systems

Situation Assessment

For two decades, companies designing and manufacturing complex system-centric products have struggled with broken processes built on Legacy PLM and reliance on informal methods.

Until recently there was little alternative. Well-resourced organizations could build their own bespoke integrations and customizations, but these are notoriously expensive and can be hard to use in practice.

But in the last few years several alternatives to Legacy PLM have emerged, which are classified in this report as Future Platforms for Hardware Engineering (FPHEV). Although new, most of these solutions have already surpassed the capabilities of Legacy PLM

systems, especially in their ability to integrate data from a large number of sources and apply AI to such tasks as BOM and change management and the creation of digital twins.

Notably, this innovation comes from new companies, not the established vendors in the market (the Big 3 and others). Individually these companies are small and lack the large marketing budgets of the Legacy PLM vendors, limiting their ability to gain the attention of future customers. It is hoped that this report will make some contribution to amplifying their capabilities collectively.

Planning for the Future

The onus is on industrial users of Legacy PLM to educate themselves and identify opportunities in their businesses to evaluate and deploy these emerging solutions. Although it's very tempting to carry on doing things the current way on the basis of "this is how we've always done it", or "change would be too risky", or "let's wait a few years and see how this plays out", or "our current vendor will have this covered, users of Legacy PLM are urged to act now to assess their current situation and pave the way for the future.

In parallel to undertaking a situation assessment, users of Legacy PLM should start evaluating the FPHE solutions identified in this report and understanding the capabilities that could be available to them. The benefits that could be gained from deploying these systems should be evaluated and compared against the cost of making change in order to generate a viable business case. Again, users of Legacy PLM are urged to act now.

Recommendations for FPHE Visionaries

Positioning

As we have seen, each of the FPHE Visionaries is small, and individually they are all pursuing new markets with new solutions. While there is no doubt about the value and the need for these solutions, making the market aware of their presence is a big challenge.

The key difference between old and the new is the ability of the FPHE Visionaries solutions to manage a much wider range of information (cross-domain and through-life) than the MCAD-centric approach of the Legacy PLM Big 3 systems. It is this difference, more than any other, that aligns the FPHE Visionaries with the needs of companies developing and building complex systems-centric products and completely undermines the legitimacy of the Legacy PLM Big 3.

Regardless of whatever focus the FPHE Visionaries are taking in their solutions and their marketing, this is the one difference they should all be putting front and center. It is the one

difference that sets them apart from their legacy competitors and which can never be challenged.

The FPHE Visionaries should therefore position themselves relative to Legacy PLM in their marketing, for the following reasons:

- It is the best way to draw the attention of the significant audience of people already invested in PLM.
- It will provide an opportunity to highlight the immediate value they can provide compared with the empty promises of the Legacy PLM vendors.
- Longer term it will provide the marketing coverage they need to further expand their solutions.

The FPHE Visionaries should also consider forming an FPHE Alliance to combine their resources and promote their vision of the future.

Benefit Claims

PLM users have long-since grown weary of the benefit claims of the Legacy PLM vendors. Time, cost, and quality has been the mantra since the earliest days of PDM in the 1980s (see Appendix). However, all that can be reliably quantified is:

- The time to implement and maintain Legacy PLM systems
- The cost (initial perpetual licenses, maintenance, implementation consulting costs, subscription cost, re-licensing for the Cloud, and now for AI-enablement).
- The poor quality of the Legacy PLM working environment and the numerous work-arounds required to address its shortcomings.

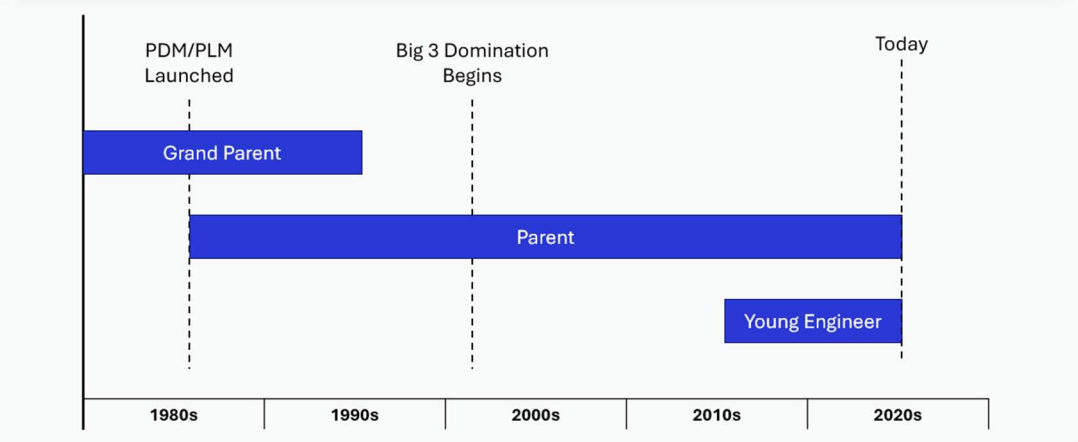
The FPHE Visionaries therefore need to tread carefully in claiming benefits. Starting small with very tangible benefits is probably more appropriate at this stage. For example, highlighting man-hours saved versus reduced time to market for new products. Arguably, the bigger benefits previously claimed by Legacy PLM are still valid and many have been summarized in a prior section. The FPHE Visionaries should use these as a guide to the benefits they themselves claim.

Conclusions

1. Industrial companies using Legacy PLM systems are holding back their businesses, with ad hoc processes used to integrate silos and reliance on email and spreadsheets to communicate. There are many FPHE solutions available that can replace Legacy PLM. Industrial users should begin evaluations urgently and formulate plans to reduce their reliance on Legacy PLM systems.
2. FPHE Visionaries should be clear in their marketing that they are targeting companies who are currently using Legacy PLM or would consider doing so. They should make their current differentiation clear and promote a roadmap that shows an increasing scope of the lifecycle workload currently being undertaken by ad hoc means being absorbed into their platforms. They should also consider forming an FPHE Alliance to combine their marketing resources and advocate collectively for their category.
3. The wider PLM community – press, analysts, the media, event organizers, etc. - should include the FPHE category in their coverage and activities. The analysts in particular have a duty to their clients to highlight the shortcomings of Legacy PLM and point the way to the future. To do otherwise would be like ignoring the emergence of ERP in the 1990s and continuing to argue for MRP and “best of breed” systems.

Appendix 1 - How Did We Get Here?

The story starts back in the 1980s. CAD systems like CADDS from ComputerVision (CV), CATIA from Dassault Systemes (DS), and Unigraphics from UGS were being rolled out rapidly. Industrial companies were soon struggling to manage the large amounts of data being created. Enter the first generation of Product Data Management (PDM) systems, for example CV's Product Data Manager and independent PDMs (like Sherpa and Eigner), designed to index and store CAD files and make it easy to find and retrieve them.



How long ago were the 1980s? For an engineer today in their early 30s, following a career in the footsteps of two generations, the 1980s is when their grandparent still had 10 years until retirement and their parent had just started working. Many of these young engineers report that they're using the same tools as their parent did.

By the 1990s PDM was a fast-growing market. By then most of the large CAD vendors had built or acquired their own PDM systems:

- UGS – IMAN
- SDRC – DMCS, and later Metaphase
- DS – Product Manager (from IBM partnership)
- PTC – Pro/PDM, Pro/Intralink, and later Windchill

Two more CAD-independent solutions, MatrixOne and Agile, were launched mid-decade. But the independents never had a chance. The CAD vendors had large and rapidly growing customer bases and by the mid-90s their MCAD-centric PDM solutions were dominating the marketplace. Y2K tied a bow around this as industrial companies discarded older, niche solutions.

Meanwhile, product complexity was increasing dramatically. In the 80s, mechanical parts still dominated most products, but the inclusion of electronics and embedded software was well underway by the 90s. This meant engineers from different disciplines now had to work together and the scope of processes and tools was expanding.

The early 2000s saw further consolidation:

- UGS acquired SDRC merging IMAN and Metaphase into Teamcenter
- DS acquired MatrixOne rebranding it as Enovia

The MCAD/PDM market had now narrowed three companies. At the same time Gartner and CIMdata rebranded PDM as Product Lifecycle Management (PLM). A new name promising greater scope, but the technology remained the same. UGS was acquired by Siemens in 2007 giving us the Big 3 names we see today we see today – Siemens, DS, and PTC.

More independents arrived in the 2000s and 2010s - Aras, Arena (originally BOM.com and now owned by PTC), and Propel. SAP developed their own PLM product and Oracle acquired Agile but neither has made PLM prominent in their portfolios. None of these more recent arrivals has been a significant challenge to the Big 3.

That was all more than 20 years ago. Surely a lot has changed since then? Product complexity has continued to increase at an even faster rate. But despite this increase, none of the Big 3 Legacy PLM vendors have taken steps to fully address the coverage gap, with MCAD still being the focal point of their solutions. Instead, they have largely focused on rebranding, rehosting, and re-monetizing their Legacy PLM products. The PLM systems of today are little changed from the PDM systems of the 1990s.

Appendix 2 – FPHE Capability Comparison

Cognyx

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Pulls data from CAD, PLM, MES, and ERP into a knowledge graph with a standard ontology.
Item Management		No. Items are replicated but are not under lifecycle management.
Relationships Between Managed Items	✓	Collaborative interface allows users to work together to build concept BOMs, eBOMs and mBOMs
Data Transfer Workflows		Not available.
User Communications	✓	User discussions are stored with each BOM.
User Applications	✓	Simulate eBOMs using MBSE, perform BOM costing, evaluate CO2 compliance and transform into mBOM.
Open to AI	✓	AI optimizes BOMs based on constraints and rules.

Dalus

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Integration with OnShape and others coming soon.
Item Management	✓	Yes.
Relationships Between Managed Items	✓	Yes, per SysML.
Data Transfer Workflows		Not available.
User Communications	✓	Yes.
User Applications	✓	Requirements, system architecture, analysis, test cases, verification & validation, etc.
Open to AI	✓	AI generates system architecture, retrieves stored knowledge, and identifies design issues.

EXP Software

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Product and processes information from PLM, CAD, ERP, OT, IoT, simulation tools, and others.
Item Management		No. Source data stays connected instead of being copied into the platform.
Relationships Between Managed Items	✓	The platform uses a relational graph to link all relevant entities across systems, roles, and responsibilities.
Data Transfer Workflows	✓	Orchestrates event-driven integrations.
User Communications		No.
User Applications	✓	Supports navigation, impact analysis, collaboration, traceability, and AI assisted engineering workflows.
Open to AI	✓	Yes, an AI module can interact with the digital twins.

Flow Engineering

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Unclear. May be limited to requirements, interfaces, design artifacts, and test cases.
Item Management		No.
Relationships Between Managed Items	✓	Yes, per systems model.
Data Transfer Workflows		No.
User Communications		No.
User Applications	✓	Change impact, test coverage, and requirements verification. Also mass, cost and power budget management and safety and regulatory compliance.
Open to AI	✓	Yes.

Intercax

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Good range of connectors to design and general tools. No downstream connectors.
Item Management		No. Connected data is federated.
Relationships Between Managed Items	✓	Yes, per MBSE model.
Data Transfer Workflows	✓	Yes, but appears limited to data loading and reporting.
User Communications		No.
User Applications	✓	Configuration management but no mention of change management.
Open to AI		No.

Makersite

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Connects to CAD, ERP, and PLM systems to import BOM or product files.
Item Management		Unclear, likely federated.
Relationships Between Managed Items	✓	Yes. May be imported or created within the platform.
Data Transfer Workflows		No.
User Communications		No.
User Applications	✓	Multiple applications analyze products, manufacturing processes, and supply chain data to assess environmental footprints, costing, compliance risks, and other criteria.
Open to AI		No.

SPREAD

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Connects to PLM, CAD, ERP, simulation, and test management systems including Teamcenter, Windchill, 3DEXPERIENCE, SAP, etc.
Item Management		No. Data is federated using standard ontology.
Relationships Between Managed Items	✓	Yes.
Data Transfer Workflows		No.
User Communications		No.
User Applications	✓	Requirements management.
Open to AI	✓	Yes.

Violet Labs

Capabilities		Notes
Full Product and Lifecycle Information Access	✓	Integrations to over 70 tools and systems – CAD, CAE, Dev Tools, ALM, Requirements, MBSE, Simulation, PDM, PLM, ERP, MES, QMS, Supply Chain, Testing, etc. with standard ontology.
Item Management	✓	Item syncing, file import, status management.
Relationships Between Managed Items	✓	Yes, supports relationship building between any managed items.
Data Transfer Workflows	✓	Data can be ingested and synchronized on schedule or as required.
User Communications	✓	Yes.
User Applications	✓	Requirements Management, Verification & Validation, Scripted Calculations, MBSE Import & Export, Inventory Engine
Open to AI	✓	Violet chatbot. MCP provides access to external agents.