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WHITE PAPER

Council on Competitiveness Study of ISVs Serving the High Performance Computing Market: Part B — End-User Perspectives

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February 2006

Commissioned by the Council on Competitiveness
Sponsored by the Defense Advanced Research Projects Agency

EXECUTIVE SUMMARY

This survey is Part B of the two-part study *Council on Competitiveness Study of the Need for Better Application Software* sponsored by the Defense Advanced Research Projects Agency (DARPA). It is a survey of industrial end users or buyers of HPC systems, and it explores their views and concerns about independent software vendor (ISV) application software and other barriers to using high-performance computing (HPC) more aggressively for competitive advantage. Part A[1] of the study was the first independent, extensive assessment of the landscape and market dynamics surrounding independent software vendors that serve high-performance computing users.

An important impetus for undertaking this study was the July 2004 *Council on Competitiveness Study of U.S. Industrial HPC Users,*[2] also sponsored by the Defense Advanced Research Projects Agency. That 2004 study found, among other things, that 97% of the U.S. businesses surveyed could not exist, or could not compete effectively, without the use of HPC. It also revealed, along with the Council's 2004 *HPC Users Conference Report,*[3] that the lack of production-quality application software is a significant barrier preventing more aggressive use of HPC across the private sector. For U.S. industries that need to outcompete their non-U.S. competitors by outcomputing them, this is indeed a major competitive barrier. In practice, it means that large, complex, and competitively important problems, such as those encountered in designing new cars and airplanes and pharmaceuticals or increasing the yield from oil reservoirs, often cannot be solved today in reasonable time frames. While yesterday's problems may run faster, companies find it difficult to solve the new cutting-edge problems that will propel them to the head of the competitiveness pack. In effect, they are standing still. And standing still is falling behind.

Of the U.S. businesses surveyed, 97% could not exist, or could not compete effectively, without the use of HPC.

Part B of the study directly surveyed a select group of well-known U.S. businesses that are highly experienced HPC users. IDC asked them about their requirements for HPC-specific application software and related resources. The HPC end users IDC interviewed for Part B represented a wide range of industries, from defense contractors to an entertainment company and a consumer products supplier. The end users employed a correspondingly broad spectrum of ISV application codes. Not surprisingly, the most frequently named ISV codes were associated with the manufacturing industries (e.g., aerospace and automotive industries), especially to support their shared need to perform structural analysis and computational fluid dynamics simulations.

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[1] *Council on Competitiveness Study of ISVs Serving the High Performance Computing Market: Part A — Current Market Dynamics* (IDC #05C4522, July 2005) (Commissioned by the Council on Competitiveness and sponsored by the Defense Advanced Research Projects Agency)

[2] Report available at **http://www.compete.org/pdf/HPC_Users_Survey.pdf**

[3] Report available at **http://www.compete.org/hpc/hpc_conf_report.asp**

KEY FINDINGS

1. HPC-Specific ISV Application Software Is Indispensable for U.S. Industrial Competitiveness

Four out of five (81%) industrial end users indicated that changing current ISV application software was out of the question ("absolutely not") or highly unlikely. Dependence on current ISV suppliers is based on some combination of the software's ability to solve the end user's problem fully and accurately, the software's data format, training and certification requirements, and other factors.

Four out of five (81%) industrial end users indicated that changing current ISV application software was out of the question.

When the enormous time, money, and business disruption that a transition to different software might entail are considered, this fierce loyalty to current ISV software makes sense. Industrial HPC users often spend years using their ISV software before trusting that it consistently produces accurate results on their own crucial problems. Moving to different software could jeopardize this large investment and leave the company competitively vulnerable for a substantial transition period. Worse yet, if the replacement software could not be certified as producing accurate results, the company might no longer be able to meet regulatory and customer requirements needed to sell its products in the marketplace.

If for some reason the end user's current ISV software were no longer available, in three out of four cases (75%) the end user would be able to acquire similar software from another supplier. In the remaining cases (25%), the industrial end users would develop equivalent software themselves or with others in order to maintain business competitiveness. Make no mistake, however: Both of these courses — moving to a different ISV supplier or attempting to develop application software on their own — would expose the companies to the same substantial costs, competitive risks, and major business disruption described above.

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It is important to note that in the absence of their familiar ISV application software, none of the industrial end users would cease using HPC to solve these crucial problems. This corroborates the July 2004 *Council on Competitiveness Study of U.S. Industrial HPC Users,* sponsored by the Defense Advanced Research Projects Agency. The 2004 study found, among other things, that 97% of the U.S. businesses surveyed could not exist, or could not compete effectively, without the use of high-performance computing.

"We depend on our ISV software."

"We know and trust the results on our current ISV codes. It takes years to prove the results are correct."

2. Virtually All of the Firms Said They Have Larger Problems That They Can't Solve Today

Respondents indicated that large, complex, and competitively important problems, such as those encountered in designing new cars and airplanes and pharmaceuticals or those increasing the yield from oil reservoirs, often cannot be solved today in reasonable time frames. While yesterday's problems may run faster, companies find it difficult to solve the new, cutting-edge problems that will propel them to the head of the competitiveness class.

Most of the firms (83%) said they have unsolvable problems that are 5–100 times larger than the problems they can solve today, although for one U.S. company this figure climbed to 100,000. Also, it is important to note that when industrial HPC end users talk about solving larger problems, they typically don't mean simply doing more of the same thing. In most cases, they mean solving problems with greater resolution that can lead to new insights and superior new products.

Most of the firms (83%) said they have unsolvable problems that are 5–100 times larger than the problems they can solve today.

3. For Many Industrial HPC Users, There Are Substantial Barriers Preventing Them from Using HPC More Aggressively for Competitive Advantage

Respondents cited both financial and technical barriers that are preventing them from using HPC more aggressively. A frequently cited obstacle was inflexible pricing of some ISV application software — a mismatch between the ISV's pricing model and the way in which the industrial buyer would ideally like to use the software. This mismatch echoes concerns IDC raised in Part A of this study about the ability of ISV pricing models to keep pace with current developments in HPC hardware systems. Will ISVs pricing by the number of computers charge the same amount for a 10,000-processor server as for a 100-processor server? How will ISVs pricing by the number of processors count the emerging wave of multicore processors? Clearly, the industrial end users are already starting to wrestle with these issues today.

A frequently cited obstacle was inflexible pricing of some ISV application software.

But it isn't just the cost of software (and hardware) that restricts the use of HPC for gaining competitive advantage in commercial markets. Even if money were no object, the capabilities of currently available hardware were judged inadequate by nearly half (46%) of the industrial firms, and software capabilities were lacking for about one-third (31%) of the respondents. IDC knows from other recent research, for example, that the limited scalability of ISV application software is the main barrier blocking the automotive and aerospace industries from using HPC to even better advantage. Software certification and data formats are training problems that also represent additional barriers.

"Current hardware and software architectures aren't ready to take full advantage of massively parallel operations."

"High-performance hardware and software aren't available."

"Hardware growth is not being matched by software growth in scaling, performance, or business model."

"Software costs are too high."

"We're moderately dependent on the formats of the MAYA file and MENTAL RAY files."

4. A Majority of the U.S. Firms Are Developing Application Software on Their Own, but Only to a Limited Extent and Often with Reluctance

A substantial majority (86%) of the industrial firms indicated they are already developing some application software on their own. The accompanying comments tell the real story, however: Many of the businesses tackle application software only to a limited extent, and even then often with reluctance. In most cases, the application software the industrial firms plan to develop in-house is not intended to replace software they acquire from ISV suppliers. As mentioned in key finding 1, attempting to develop application software on their own would expose the companies to substantial costs, competitive risks, and major business disruption, up to and including the possibility of not being able to introduce or sell their products in the marketplace.

"[Developing our own application software] is too costly in all respects."

"Total cost of ownership is quite expensive for do-it-yourself software."

"We have very little ability to do it ourselves."

"We used to develop our own software, but it is too costly these days."

"We used to develop our own software, but it is too costly these days."

5. Three-Quarters of the U.S. Firms Could Benefit from a Petascale Computer System

Three-quarters of the industrial firms (73%) said they could make use of a petascale computer to run today's crucial problems faster or to tackle next-generation problems of great competitive importance. This is an interesting finding, given that industrial users usually acquire substantially smaller versions of HPC systems than do leading government and academic users. But commercial computer purchases are more heavily dictated by budgets, and the fact that industrial firms have more modest HPC budgets than leading government users does not mean the companies have smaller ambitions for applying HPC. For example, the majority of the industrial end users said they would (83%) or might (91%) use a petascale computer to run heterogeneous problems. A heterogeneous problem, also called a multiphysics or multidisciplinary problem, is one that involves multiple scientific disciplines — for example, studying the complex interaction between the structure of an automobile and the fluid dynamics of air flow around it.

The majority of the industrial end users said they would (83%) or might (91%) use a petascale computer to run heterogeneous problems.

One of the major findings of Part A of this study was that there is a lack of readiness for petascale systems among the ISV suppliers. Fewer than half (46%) of the ISV applications scale even to hundreds of processors today, and 40% of the applications have no immediate plans to scale to this level. Very few codes scale to thousands of processors today or are being aimed at this level of scalability. If current development time frames continue, when petascale systems become available, the majority of ISV codes will not be able to take full advantage of them for at least three to five years.

Fewer than half (46%) of the ISV applications scale even to hundreds of processors today.

"We could do a full engine simulation."

"We could do real-time rendering of full-resolution frames of CG [computer-generated] films. We could also do real-time simulation of clothing, hair, fur, feathers, fluids, etc."

"We could push the envelope with new science and more refined models."

"We could do calculations to define the parameters and do physics that we don't understand today."

6. Market Forces Alone Will Not Address This Problem

Previously, an ISV attempting to improve the performance of application software on a vendor's hardware product collaborated directly with that vendor. The vendor operated on large margins and invested substantial human and financial resources in the collaborative effort. In today's commoditized, lower-margin market for HPC hardware, neither ISV organizations nor HPC hardware vendors can afford to make major new R&D investments to fundamentally rewrite application software to take advantage of highly scalable systems. At the same time, U.S. firms are engaged in intense competition for global market leadership in their own industries and generally don't have the time, resources, or desire to be "in the business" of also developing application software. Their current work on application software is limited and often undertaken with reluctance; in most cases it is not intended to replace the end user's ISV application software. In sum, market forces alone will not address the gap between HPC end users' needs and ISV application software capabilities. Market forces need to be supplemented with external funding support and expertise to improve the scalability of ISV software that is needed for improving the competitiveness of U.S. businesses.

"Few [ISV] vendors are looking out as far as the leading edge of our industry needs to look. The investment from our commercial vendors is limited and is generally focused on market share and commodity, pro-sumer markets."

"We explored solid and fluid mechanics with our ISV and didn't reach a satisfactory conclusion. They said it was too much of an investment and I'd have to foot the entire development bill to address my problem. The ISVs won't take the risk."

"[Developing our own application software] is too costly in all respects."

"[Developing our own application software] is too costly in all respects."

7. Nearly Half the U.S. Firms Would Be Willing to Partner with Outside Parties to Develop Application Software, Though Some Have Concerns

Among the partner types, U.S. firms are most interested in collaborating with ISVs (67%). National labs and universities were tied (50% positive responses each) as the second-most-popular potential partners for collaborations related to application development. Government agencies were also viewed favorably (42% positive responses), though not as favorably as ISV suppliers, national labs, or universities. Easily the least-favored type of category for potential collaboration consisted of "competitors in the company's own industry." To help complete the picture, we asked the industrial end users whether they had concerns about working with non-U.S. partners. A small majority (54%) replied yes.

"We'd had very good experience [with ISV partnerships] across our industry and will continue doing this."

"We'd had very good experience [with ISV partnerships] across our industry and will continue doing this."

"We love working with labs."

"Our experience with agencies has been very positive."

"We'd want exclusive use of the results for a period of time."

"We're open to partnerships but would want to maintain our competitive advantage in our core industry."

"We'd want a partnership where the scope, goals, and methods are agreed upon in the beginning and we are an active partner."

IMPLICATIONS OF THE FULL STUDY: OBSERVATIONS FROM PART A AND PART B

How the End Users' Views Align with the ISVs' Views

Table 1 lists the key findings from Part A (the ISVs' view) and Part B (the end users' view) of the study. The juxtaposed findings reveal the large disparity between the need of U.S. businesses to use HPC more aggressively for competitive advantage, and the current plans of ISV suppliers to meet this crucial need. The limitations of HPC-specific ISV application software are not the only barrier to fuller exploitation of HPC but are regularly cited by industrial end users as the most important constraint.

TABLE 1

Comparison of Key Findings

Study Part A: ISV Suppliers	Study Part B: HPC End Users
The business model for HPC-specific application software has all but evaporated in the last decade.	HPC-specific ISV application software is indispensable for U.S. industrial competitiveness.
ISV applications can exploit only a fraction of the problem-solving power of today's high-performance computers.	Virtually all of the firms said they have larger problems that they can't solve today.
For many applications, the ISVs know how to improve scalability but have no plans to do so because the HPC market is too small to justify the R&D investment.	The lack of scalable application software is preventing many industrial users from using HPC more aggressively for competitive advantage.
There is a lack of readiness among ISV suppliers for petascale systems.	Three-quarters of the U.S. firms could benefit from a petascale computer system.
Market forces alone will not address the gap between HPC users' needs and ISV software capabilities.	Market forces alone will not address the gap between HPC users' needs and ISV software capabilities.
Most ISVs would be willing to partner with outside parties to accelerate application software development.	Nearly half the firms would be willing to partner with outside parties to accelerate application software development.

Source: IDC, 2006

Implications of the Study

U.S. industry has long been a global leader in exploiting HPC to drive product innovation. This innovation has given U.S. businesses an important marketplace advantage over competitors from nations with lower labor costs or lesser ability to exploit HPC. In the past decade, however, the ISVs' business model for developing HPC-specific application software has nearly evaporated. As a result, key U.S. industries often do not have the ISV software they want and need. This has rendered them incapable of innovating as aggressively as they would like, and has compromised U.S. industrial competitiveness. Market forces alone can no longer correct this problem; they need to be supplemented with external funding and expertise. Fortunately, most ISVs and a substantial portion of the U.S. businesses are willing to partner with outside parties to speed progress in creating more capable HPC application software.

PART B METHODOLOGY

Definitions: Additional Terminology for Part B

Certification

Certification guarantees that the computer simulation of a scientific or engineering problem will match experimental ("real world") results within a certain window of accuracy. Certification in this context refers to an ISV supplier's "stamp of approval" that one of its applications runs compatibly and accurately, and in compliance with any applicable regulatory requirements, on a specific HPC computer product (e.g., Cray XT3, HP Integrity Superdome, IBM Blue Gene/L, SGI Altix, Voltaire Pinnacle). Given the substantial number of HPC hardware and operating system variants (Unix and Linux derivatives, Windows) in the market today, ISV suppliers — many of which are small businesses — may lack the financial and human resources to certify, in a timely manner, a version of their codes for every variant. Considering that one of the main purposes of certification is to ensure that an application is producing accurate results, lack of certification can pose major problems for U.S. businesses that are engaged in life-and-death battles to bring higher-quality products to market ahead of their global competitors. If application software cannot be certified as producing accurate results, the company might not be able to meet regulatory and customer requirements needed to sell its products in the marketplace.

Data Formats

In the context of this study, data formats refer to unique ways in which data are arranged for processing, storage, and visual display. Familiar examples of data formats from the world of desktop applications include Microsoft PowerPoint (.ppt format), Microsoft Word (.doc format), and Adobe Reader (.pdf format). In the high-performance computing realm, there are hundreds of ISV applications and scores of unique, proprietary data formats. A major complaint of HPC end users, according to recent IDC research, is that ISV software applications often cannot "talk to" each other; that is, data from one application can't be deciphered, for the purposes of combining or comparing results, by applications with different data formats.

Study Background — Part B

Part A of this study provided the first extensive, independent assessment of the landscape and market dynamics surrounding ISVs that serve HPC users. In summary, Part A concluded that the ISVs' business model for creating HPC-specific application software has all but evaporated in the past decade, and market forces alone will not address the need of U.S. businesses for applications they can use to exploit HPC more aggressively for global competitive advantage. Market forces need to be supplemented with external funding support and expertise to improve the scalability of ISV software that is needed for improving the competitiveness of U.S. businesses. If this support were available, most ISV organizations would be willing to partner with outside parties to accelerate progress.

Part B of the study directly surveyed a select group of well-known U.S. businesses that are highly experienced HPC users. IDC asked them about their requirements for HPC-specific application software and related resources to supplement the broader discussion that occurred at the Council on Competitiveness Users Conference and Software Workshop (July 13 and14, 2005). Part B complements and expands on the results of IDC's July 2004 *Council on Competitiveness Study of U.S. Industrial HPC Users*. This study found that among the criteria for purchasing high-performance computers, "performance on our applications" was most prominent. In the battles U.S. businesses wage for global market supremacy, faster application performance often means faster time to market and superior products.

In the July 2004 study, IDC asked the U.S. businesses about their interest in a hypothetical high-performance computer 100 times faster than today's models — analogous to questions in the present study about petascale computers. The 2004 respondents first cautioned that it is not sufficient to imagine a machine that is merely 100 times faster theoretically — the machine would need to be 100 times faster than today's high-performance computers when running users' own ISV applications. As the chief benefit of a dramatically faster computer like this, they then cited the ability to produce higher-quality products. Those who were able to quantify this benefit named figures ranging from $10 million to several billion dollars for their organization alone. Other positive effects of better high-performance computers included more powerful pharmaceutical drugs and faster disease cures, more environmentally friendly manufacturing, reduced litigation expense, and more-entertaining animated films.

As a preface to this study, it is important to note that the U.S. businesses participating in the July 2004 study stressed that for the foreseeable future, the crucial competitive benefits of HPC will remain heavily dependent not just on faster hardware servers, but on the capabilities of ISV application software.

Methodology — Part B

This study is based on interviews of 13 well-known U.S. commercial firms that are important end users of high-performance computing, combined with five in-depth interviews of end users. Part B was not intended to be a large industrial user survey. IDC selected a targeted group of highly experienced HPC users for a benchmark response to Part A of the study. These industrial HPC end users represented a wide range of industries and employed a correspondingly broad spectrum of ISV applications codes. The primary industries of the survey respondents spanned seven sectors, from defense contractors in the aerospace industry to an entertainment company and a consumer products supplier. The interviews included a mix of multiple choice, quantitative, and qualitative questions. To the extent possible within the pragmatic time limits of the interviews, we elicited additional comments on the topics in question. This document includes a representative sampling of the comments.

Study Limitations — Part B

While IDC aims to provide an accurate, comprehensive view of the subject being studied, certain limitations inevitably affect the results. Based on other recent IDC research and HPC activities, IDC believes that the opinions of the 13 industrial end-user organizations interviewed for this study fairly represent the general thinking of

the larger community of U.S. industrial HPC users. It would be presumptuous to claim, however, that there are no users in the larger U.S. industrial community whose opinions differ in certain respects from any in the group IDC interviewed for this study. Also, consistent with this study's purpose, we elected to focus on U.S. end-user companies. This study therefore does not purport to represent the opinions of non-U.S. industrial end users of HPC. Finally, with a group size of 13 end users, some less-popular options for responding to questions are thinly represented, occasionally with only one or two responses. IDC has tried to exercise extreme caution in generalizing from such results and cautions readers to do the same.

PART B STUDY RESULTS

The Part A study results are available from the Council on Competitiveness at **www.compete.org/hpc**.

Industry HPC End-User Demographics

The U.S. industrial HPC end users IDC interviewed for this study represented a wide range of industries and employed a correspondingly broad spectrum of ISV application codes.

Primary Industry of End Users

When IDC asked for the primary industry of the survey respondents (see Figure 1), the replies spanned seven sectors, from defense contractors in the aerospace industry to an entertainment company and a consumer products supplier. More than half of the respondents (61%) belonged to the aerospace and automotive industries, which are often grouped together in an HPC context because they share many of the same problems (e.g., aerodynamic design, fuel efficiency) and therefore use many of the same ISV applications.

Primary Application Codes of End-Users

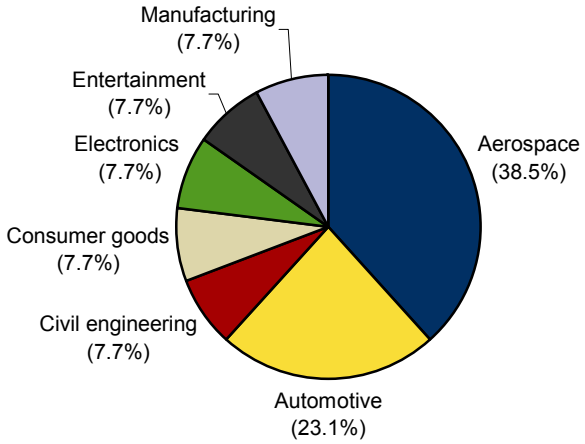
The most frequently named ISV codes are associated with the aerospace and automotive industries.

Not surprisingly (see Table 2), the most frequently named ISV codes are associated with the aerospace and automotive industries, especially to support their shared need to perform structural analysis (e.g., LS-DYNA, ABAQUS) and computational fluid dynamics (e.g., FLUENT) simulations. Even within the aerospace/automotive sector, preferences for favorite structural analysis and CFD applications varied considerably. At the other end of the spectrum is a substantial list of ISV applications mentioned only once each, such as MAYA and MENTAL RAY, both of which are used by filmmakers and others for visual rendering.

FIGURE 1

Primary Industry of End Users

Q. What is your primary industry?



n = 13

Source: IDC, 2006

TABLE 2

Primary Application Codes of End Users

Q. What are the primary ISV application codes you use for HPC?

Application Code	Most Important	Second	Third	Total Mentions
FLUENT	2	3	1	6
ABAQUS	2	1	1	4
LS-DYNA	2	2	–	4
ANSYS	2	1	–	3
IDEAS Simulation	–	1	1	2
NASTRAN	–	–	2	2
ACCELRYS	–	–	1	1
ALLSTAR	1	–	–	1
CADENCE	1	–	–	1
CFD++	–	–	1	1
CFL3D	–	1	–	1
GAMBIT	–	1	–	1

TABLE 2

Primary Application Codes of End Users

Q. What are the primary ISV application codes you use for HPC?

Application Code	Most Important	Second	Third	Total Mentions
MAYA (ALIAS)	1	–	–	1
MENTAL RAY	–	1	–	1
MENTOR	–	–	1	1
NASTAR	–	–	1	1
NORDEX	–	–	1	1
OVERFLOW	1	–	–	1
STAR-CD	–	1	–	1
SYNOPSIS	–	1	–	1
TETRIS	–	–	1	1
Y237	–	1	–	1
Total	12	14	11	37

Source: IDC, 2006

Percent of Applications Developed In-House Versus Externally

The ratio of applications created by the businesses themselves to applications developed externally by third parties varied greatly by industry (see Table 3). Overall, three-quarters (75%) of the applications being used by these organizations were acquired from external ISV vendors, with the remainder (25%) developed in-house. Looking beyond the single consumer goods company that used outside codes exclusively (100%), the automotive (97%) and aerospace (72%) firms relied most heavily on external ISV application software. The major ISV codes serving these two sectors, and to some extent the manufacturing sector as well, typically are of older origin and have stood the test of time. At the opposite extreme, the entertainment industry firm depended minimally (20%) on outside applications that are newer and less well tuned to the company's requirements.

TABLE 3

Percent of Applications Developed In-House Versus Externally

Q. What percent of your applications are developed internally and what percent are developed externally?

		Mean (%)	
Industry	Number	In-House	External
Consumer goods	1	–	100
Automotive	3	3	97
Aerospace	5	28	72
Manufacturing	1	30	70
Electronics	1	40	60
Entertainment	1	80	20
Total	12	25	75

Source: IDC, 2006

Dependence on ISV Application Software Vendors

Lock-In to ISV Supplier

Roughly three-quarters (73%) of the industry organizations said they are not "locked in" to their current ISV application vendors through formal agreements (see Figure 2). Even for this majority, however, the contractual freedom to change is often tempered by practical dependence on the ISV applications for day-to-day business operations. This practical dependence presumably is greatest in sectors, like the aerospace and automotive industries, that make heaviest use of third-party ISV codes (refer back to Table 3).

"We have some two-, three-, and five-year agreements, but none are exclusive."

"We have some two-, three-, and five-year agreements, but none are exclusive."

Training Issues with ISV Supplier

Most (58%) of the businesses said they had training problems with their ISV application vendors (see Figure 3), though a significant number (42%) reported no problems. Comments cited the cost of training and the fact that training requirements can vary greatly by application. Most also (58%) replied yes when asked whether current training problems would affect a decision to change ISV suppliers (see Figure 4).

"Training is available from our ISV, but it would be expensive to retrain all the engineers in our group."

"Our training issues range from significant to limited, depending on the application."

"Yes, but they can be overcome."

"Yes. Our code has a relatively small user base but is highly powerful. It's complex to use and requires good training."

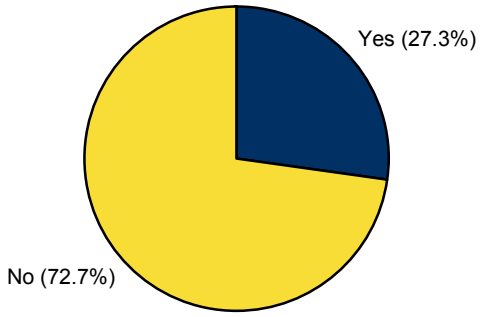
"Yes. Training's a big factor."

"No. Training wouldn't prevent us from changing."

FIGURE 2

Lock-In to ISV Supplier

Q. Are you locked in to your current ISV application suppliers?



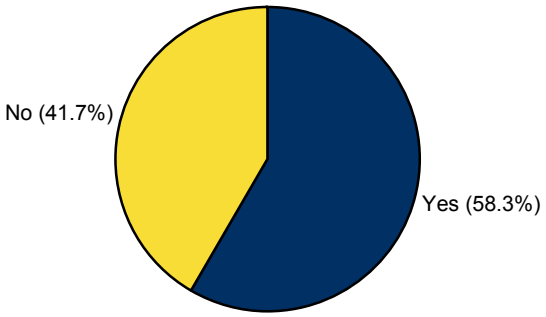
n = 11

Source: IDC, 2006

FIGURE 3

Training Problems with ISV Supplier

Q. Do you have training problems with your current ISV application suppliers?

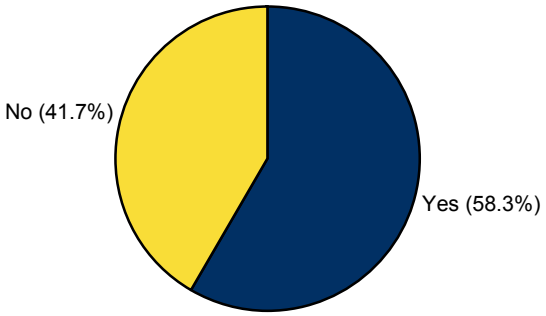


n = 12

Source: IDC, 2006

FIGURE 4

Training Issues Affecting Changing ISV Supplier



n = 12

Source: IDC, 2006

Certification Issues with ISV Supplier

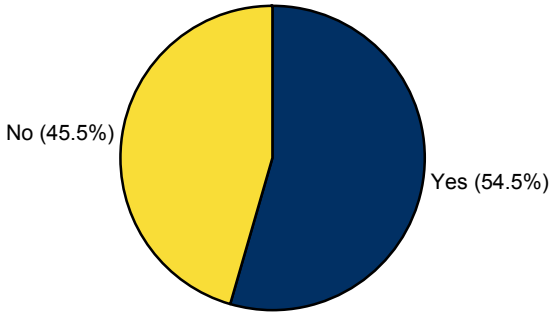
More than half (55%) of the respondents affirmed that they had certification problems with their ISV suppliers (see Figure 5). Certification in this context refers to an ISV supplier's "stamp of approval" that one of its applications runs compatibly and accurately, and in compliance with any applicable regulatory requirements, on a specific HPC computer product (e.g., Cray XT3, HP Integrity Superdome, IBM Blue Gene/L, SGI Altix, Voltaire Pinnacle). Given the substantial number of HPC hardware and operating system variants (Unix and Linux derivatives, Windows) in the market today, ISV suppliers — many of which are small businesses — may lack the financial and human resources to certify in a timely manner a version of their codes for every variant. Considering that one of the main purposes of certification is to ensure that an application is producing accurate results, lack of certification can pose major problems for U.S. businesses that are engaged in life-and-death battles to bring higher-quality products to market ahead of their global competitors. If application software cannot be certified as producing accurate results, the company might not be able to meet regulatory and customer requirements needed to sell its products in the marketplace.

More than half (55%) of the respondents affirmed that they had certification problems with their ISV suppliers.

FIGURE 5

Certification Issues with ISV Supplier

Q. Do you have certification problems with your current ISV application suppliers?



n = 11

Source: IDC, 2006

Data Format Dependence on ISV Supplier

A major complaint of HPC end users, according to recent IDC research, is that ISV software applications often cannot "talk to" each other; that is, data from one application can't be deciphered by other applications for the purposes of combining or comparing results. This limitation can be especially frustrating for businesses that want to gain competitive advantage by tackling heterogeneous problems, also called multiphysics or multidisciplinary problems. Heterogeneous problems involve multiple scientific disciplines — for example, studying the complex interaction between the structure of an automobile (structural analysis) and the air flow surrounding the vehicle (computational fluid dynamics).

An important reason for the incompatibility among many ISV applications is varying data formats — unique ways in which data are arranged for processing, storage, and visual display. Familiar examples of data formats from the world of desktop applications include Microsoft PowerPoint (.ppt format), Microsoft Word (.doc format), and Adobe Reader (.pdf format). In the high-performance computing realm, there are hundreds of ISV applications and scores of unique, proprietary data formats.

It is therefore not surprising that more than three-quarters (78%) of the industry respondents in this study pointed to data format dependence on ISV suppliers as a serious constraint (see Figure 6).

More than three-quarters (78%) of the industry respondents in this study pointed to data format dependence on ISV suppliers as a serious constraint.

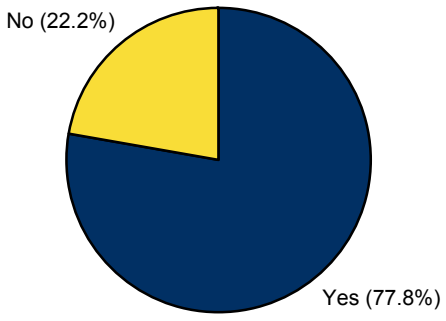
"We're moderately dependent on the formats of the MAYA file and MENTAL RAY files."

"The translation of FEA models between the West Coast and East Coast can be difficult."

FIGURE 6

Data Format Dependence on ISV Supplier

Q. Do you have data format dependence on your current ISV application suppliers?



n = 9

Source: IDC, 2006

Likelihood of Changing ISV Software

Four out of five (81%) of the responses to this question indicated that changing current ISV software was out of the question ("absolutely not") or highly unlikely, even if the end users could change if they so desired (see Figure 7). Only one respondent was actively exploring options for changing ISV software.

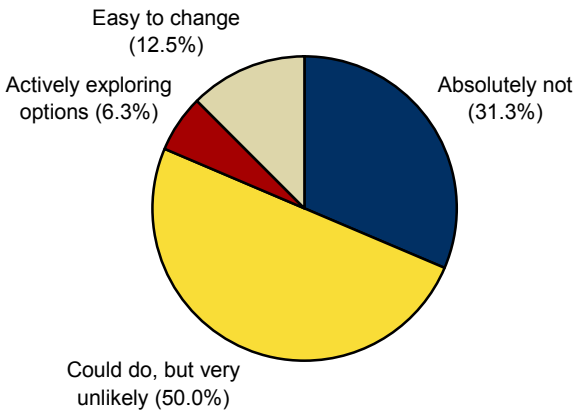
Four out of five (81%) of the responses to this question indicated that changing current ISV software was out of the question ("absolutely not") or highly unlikely.

When the enormous time, money, and business disruptions that a transition to different software might entail are considered, this fierce loyalty to current ISV software makes sense. Industrial HPC users often spend years using their ISV software before trusting that it consistently produces accurate results on their own crucial problems. Moving to different software would jeopardize this large investment and leave the company competitively vulnerable for a substantial transition period. Worse yet, if the replacement software could not be certified as producing accurate results, the company might no longer be able to sell its products in the marketplace. From a business standpoint, a major disruption like this is highly impractical and to be avoided at almost any cost.

FIGURE 7

Likelihood of Changing ISV Software

Q. What is the likelihood you will change your current ISV application software?



n = 16

Note: Multiple responses were allowed.

Source: IDC, 2006

Action If ISV Software Weren't Available

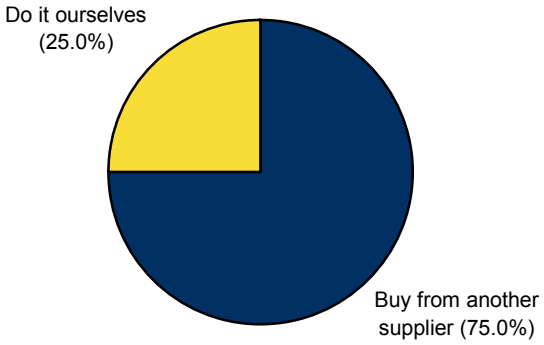
If for some reason the end user's current ISV software were no longer available, in three out of four cases (75%), the end user would be able to acquire similar software from another supplier (see Figure 8). In the remaining cases (25%), the industrial end users would develop equivalent software themselves, either because they preferred the do-it-yourself route or lacked other options. Make no mistake, however: Both of these courses — moving to a different ISV supplier or attempting to develop application software on their own — would expose the companies to the same substantial costs, competitive risks, and major business disruption described in the preceding question (refer back to Figure 7). It could take hundreds, even thousands, of person years to recreate an ISV software application, and even then questions would remain for some time about its efficacy in solving company-specific problems.

What is interesting about responses to the current question, however, is that in the absence of their familiar ISV application software, none of the industrial end users would cease using HPC to solve these crucial problems. This corroborates IDC's July 2004 *Council on Competitiveness Study of U.S. Industrial HPC Users,* which was sponsored by the Defense Advanced Research Projects Agency. The 2004 study found, among other things, that 97% of the U.S. businesses surveyed could not exist, or could not compete effectively, without the use of high-performance computing.

FIGURE 8

Action If ISV Software Weren't Available

Q. What would you do if your current ISV application software were no longer available?



n = 16

Note: Multiple responses were allowed.

Source: IDC, 2006

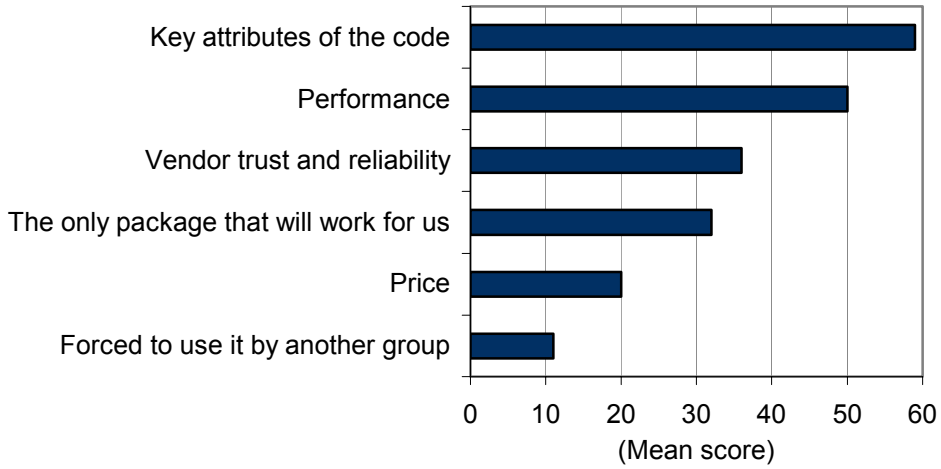
Criteria for Selecting Current ISV Software

As Figure 9 shows, the most important criterion for selecting the industrial end user's current ISV application software was the "key attributes of the code" (average rating: 59%). "Key attributes" refers to the fit between the application software and the technical computing problem the user is attempting to tackle (i.e., the software's ability to solve the problem fully and accurately). Because the industrial problems in question are tightly linked to product development and therefore corporate success, it is not surprising that application codes with the right key attributes emerged as the top criterion for end users.

FIGURE 9

Criteria for Selecting Current ISV Software

Q. On a scale of 0–100%, where 100% defines the highest possible importance, rate each of the criteria you used for selecting your current ISV application software.



n = 12

Source: IDC, 2006

Next in importance (50% average rating) was the application software's speed ("performance") in solving the problem. Faster problem-solving speed can mean faster time to market for new products. Running a distant third and fourth in the ratings were vendor reliability (36%) and software uniquely able to solve the problem (32%).

Interestingly, price as a criterion for selecting ISV application software came in next to last (20%), ahead of only the situation in which a group was forced to use an ISV software package by another group in the same company (11%). Yet other IDC research shows that the costs of ISV application software are especially burdensome for industry. In Part A of this study[4], the ISV organizations reported that applications software costs approached 50% of overall HPC costs for businesses, versus only 5–15% for academic users and 5–10% for government users, who often develop their own software codes for the research they pursue. IDC also knows from other research that software costs become even more onerous as users scale up the size of their hardware systems. In spite of this, "key attributes of the code" take precedence over price and other factors because industrial firms are highly dependent on ISV codes for their survival and success. ISV software typically plays an important but less crucial role in academic and government organizations.

Interestingly, price as a criterion for selecting ISV application software came in next to last (20%).

Key Weaknesses of Current ISV Software

"Limited scalability" and "inflexible licensing model" (23% of the responses each) were the most frequently cited weaknesses of industrial end users' current ISV application software (see Table 4).

As used in this study, scalability means the ability of application software to effectively exploit more processors on an HPC computer server in order to solve current problems faster and with greater resolution and to effectively address more-complex next-generation problems. The largest HPC systems may have hundreds or even thousands of processors today, growing to tens of thousands in the near future, yet Part A of this study (see key finding 2) showed that many applications popular in industry today can exploit only 1–4 processors in practice (some scale to 16–32 processors or more). This limited scalability retards a company's ability to answer the "what if" questions that provide new insights needed to drive the process of innovation.

Industrial end users' complaints about "inflexible licensing models" generally point to a mismatch between the ISV's pricing model and the way in which the industrial buyer would ideally like to use the software. This mismatch echoes the concerns raised in Part A of this study, in which the ISV organizations reported their current pricing models: charging by the number of users, by the number of processors the application can be run on, and by issuing site licenses for unrestricted use. IDC said then, and repeats here, that it will be interesting — and important — to see how ISV organizations grapple with current developments in HPC hardware systems. Will those pricing by the number of computers charge the same amount for a 10,000-processor server as for a 100-processor server? How will those pricing by the number of processors count the emerging wave of multicore processors? Clearly, the industrial end users are already starting to wrestle with these issues today.

Industrial end users' complaints about "inflexible licensing models" generally point to a mismatch between the ISV's pricing model and the way in which the industrial buyer would ideally like to use the software.

Beyond these two frequently cited weaknesses, a long list of other drawbacks received single mentions: performance, price/costs, lack of openness, limited future functionality, show enhancements, lack of support for problems, and incompatibility with other codes.

[4] See *Council on Competitiveness Study of ISVs Serving the High Performance Computing Market: Part A — Current Market Dynamics*, available at **www.compete.org/hpc**.

TABLE 4

Key Weaknesses of Current ISV Software

Q. What are the key weaknesses of your current ISV application software?

	Number	% of Respondents
Limited scalability	3	23.1
Inflexible licensing model	3	23.1
Performance	1	7.7
Price/costs	1	7.7
Lack of openness	1	7.7
Limited future functionality	1	7.7
Slow enhancements	1	7.7
Lack of support for problems	1	7.7
Incompatibility with other codes	1	7.7
Total	13	100.0

Source: IDC, 2006

Stress Points with Current ISV Software

As a cross-check, we used a different format to ask again about end users' problems with current ISV application software. Once again (see Table 5), "scaling ability" (limited scalability) clearly emerged as the most important problem (42% average rating), following by pricing model (32%) and price level (31%). Other issues were less important.

TABLE 5

Stress Points with Current ISV Software

Q. On a scale of 0–100%, where 100% defines the highest possible importance, rate each of the stress points with your current ISV application software.

Stress point	Mean Score
Scaling ability	42
Pricing model	32
Price level	31
Performance	25
Missing features/functions	22
Vendor service/support	10

n = 12

Source: IDC, 2006

Change to a Different ISV Supplier

Although in response to previous questions (see Table 6) the industrial end users assigned higher importance to software scalability than price, answers to question number 6 showed that priorities can shift in a different context. When asked what would motivate them to change ISV suppliers, end users said a relatively modest 27% price improvement would be enough to trigger the move, whereas a 46% improvement in scalability or a 122% performance speedup would be needed to motivate a change in ISV suppliers.

TABLE 6

Change to a Different ISV Supplier

Q. What would it take for you to move to a different ISV supplier?

Criteria	Required Change (%)
Performance improvement	122
Scaling improvement	46
Price savings improvement	27

n = 12

Source: IDC, 2006

Desired Functionality or Features

Respondents were asked, What desired functionality or features are missing from your current ISV application software? The wish list of functions and features industrial end users would like to see included in their ISV application software ranged from the general (improved algorithms, better ease of use, more compatibility between codes) to the specific (interactive lighting interface, support for direct transient rocket analysis).

"We'd like new physics and usability features."

"The codes don't talk to each other. There are no coupled solutions."

"The codes don't talk to each other. There are no coupled solutions."

"For film rendering, we need an interactive lighting interface and better scan line performance. For another important code, scaling to complexity is a big issue, and so is working in parallel. The code needs to open access to libraries instead of through the existing limited interface."

"We need support to direct transient solid rocket analysis."

Willingness to Develop Application Software

Four out of five (79%) of the industrial end users said they were willing to develop application software themselves (see Figure 10), but even within this group there were strong reservations. Industrial HPC users often spend years using their ISV software before trusting that it consistently produces accurate results on their own crucial problems. Attempting to develop application software on their own would expose the companies to substantial costs, competitive risks, and major business disruption. It could take hundreds, even thousands of person years to recreate an ISV software application, and even then, questions would remain for some time about its efficacy in solving company-specific problems. If the replacement software could not be certified as producing accurate results, the company might no longer be able to sell its products in the marketplace. From a business standpoint, a major disruption like this is highly impractical and to be avoided at almost any cost.

"Yes, but we hate to do it."

"It's too costly in all respects."

"Total cost of ownership is quite expensive for do-it-yourself software."

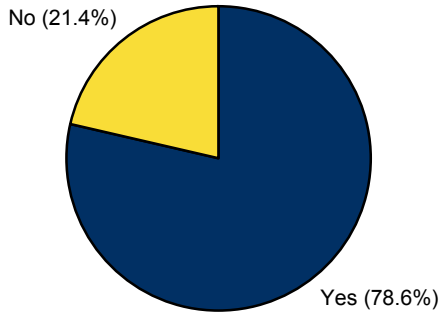
"Total cost of ownership is quite expensive for do-it-yourself software."

"We have very little ability to do it ourselves."

FIGURE 10

Willingness to Develop Application Software

Q. Are you willing to develop application software yourself?



n = 14

Note: Multiple responses were allowed.

Source: IDC, 2006

Developing Application Software

A slightly larger majority (86%) indicated they are already developing application software on their own (see Figure 11). Once again, however, the comments tell the real story: Many of the businesses tackle application software only to a very limited extent, and even then often with great reluctance.

"We generally have relied on our own software because few vendors are looking out as far as the leading edge of our Industry needs to look. The investment from our commercial vendors is limited and is generally focused on market share and commodity, pro-sumer markets."

"Yes, but only the user interface."

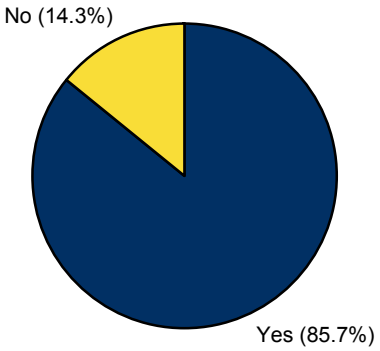
"Yes, but very limited."

"Yes, to a limited extent."

FIGURE 11

Developing Application Software

Q. Are you currently developing application software yourself?



n = 14

Note: Multiple responses were allowed.

Source: IDC, 2006

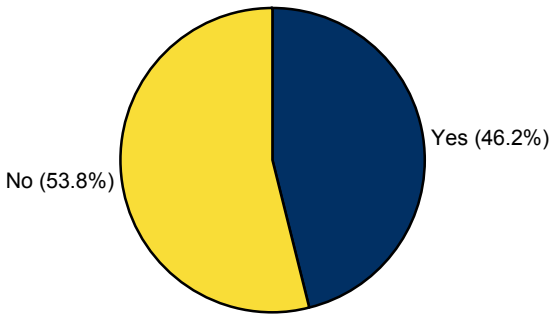
Developing Application Software with National Lab or University

As Figure 12 indicates, nearly half (46%) of the businesses are already developing application software with a national laboratory or university. This provides a strong baseline for future collaboration among these parties.

FIGURE 12

Developing Application Software with National Lab or University

Q. Are you currently developing application software with a national lab or university?



n = 13

Source: IDC, 2006

Developing Application Software in the Future

More than three-quarters (77%) of the industrial firms said they plan to develop application software in the future, as Figure 13 illustrates. Again, the comments show that, at least in some cases, the software in question may be very limited.

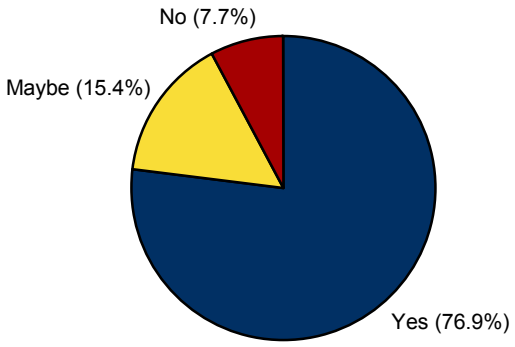
"Yes, but only user interfaces."

"To a limited extent."

FIGURE 13

Developing Application Software in the Future

Q. Do you plan to develop application software in the future?



n = 13

Source: IDC, 2006

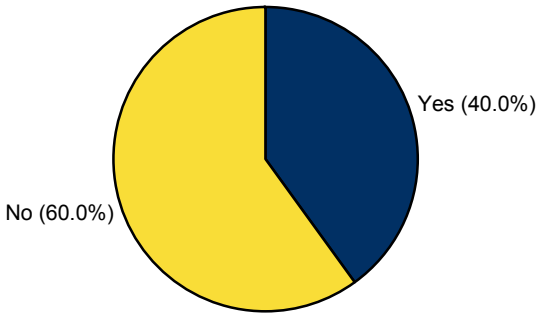
Replace External Software

In the majority of these cases (60%), the application software the industrial firms plan to develop is not intended to replace software they acquire from ISV suppliers, but in an impressive 4 out of 10 instances, the software is aimed at doing precisely that (see Figure 14).

FIGURE 14

Replacing External Software with Application Software

Q. Will your application software replace external application software from ISVs?



n = 10

Source: IDC, 2006

Interest in Working with National Lab, University, or Government Agency

When "yes" (69%) and "maybe" (23%) responses are combined, 92% of the industrial end users declared an interest in working with a national lab, university, or government agency to create application software (see Table 7). Previously in this study, we found that virtually all ISV organizations were willing to collaborate on application software develop with the government or other outside parties.

"Yes. We already work with all three types."

"Possibly. We would have to look at how much they offered versus any possible slowdown in moving to a larger team."

TABLE 7

Interest in Working with National Lab, University, or Government Agency

Q. Are you interested in working with a national laboratory, university or government agency to develop application software?

	Number	% of Respondents
Yes	9	69.2
Maybe	3	23.1
No	1	7.7
Total	13	100.0

Source: IDC, 2006

Preferred Partners for Developing Application Software

Table 8 displays the types and names of the organizations the industrial firms said they would prefer to collaborate with in developing application software (ISVs were not included in the choices for this question). As a category, government easily won out over universities by a factor of 15 to 2. Within government, the Department of Energy (DOE) emerged as the department most often preferred, obtaining 10 mentions compared with three for the Department of Defense (DOD) and two for NASA. Sandia National Laboratories and Oak Ridge National Laboratory, with the closely allied University of Tennessee, stood out as popular choices in the DOE family.

While IDC cautions against making detailed conclusions based on this polling of a limited number of industrial end users, we believe the general preference for government as an application development partner and the strong interest in the DOE labs are instructive.

Some of the respondents continued to express reservations about these external partnerships, pointing to existing relationships with ISV suppliers ("We mostly buy from ISVs") or the costs of external collaboration ("Coordination may make it more difficult and expensive in opportunity costs than doing it entirely in-house").

The "no preference" and "not sure" responses indicate that work is still needed to make HPC users in industry aware of the opportunities for partnering with public sector organizations.

"We have worked with 30 different ones in various categories."

"We like CRADA umbrellas. All that's currently required is a statement of work."

"We're currently looking at various opportunities."

"We don't know what's available."

"We have no preference."

TABLE 8

Preferred Partners for Developing Application Software

Q. Who would you prefer to partner with to develop application software?

Partner Type/Organization	Number
DOE	
Sandia	4
ORNL/UT	2
Argonne	1
LANL	1
PNNL	1
DOE unspecified	1
Subtotal	10
DOD	
Air Force	1
Navy	1
DOD unspecified	1
Subtotal	3
NASA	2
Universities	
Stanford	1
University of Minnesota	1
Subtotal	2
No preference	1
Not sure	1
Total	19

Note: Multiple responses were allowed.

Source: IDC, 2006

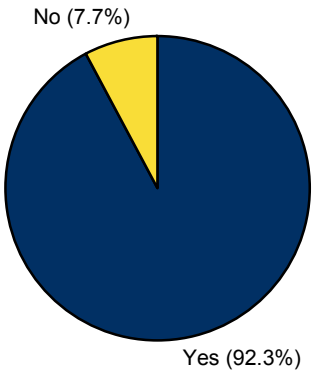
Larger Problems to Solve

Virtually all (92%) of the industrial firms said they have larger (or more intractable) problems they would like to be able to solve (see Figure 15).

FIGURE 15

Larger Problems to Solve

Q. Do you have larger problems you'd like to solve?



n = 13

Source: IDC, 2006

Size of Current Problems

To provide a baseline for comparisons with currently unsolvable problems, we asked the industrial end users about the sizes of the largest problems they are solving today (see Table 9). Although two of the respondents had large problems requiring 10 or fewer hours of CPU (processor) time to complete, the great majority (78%) of the larger problems required 100 or more CPU hours. For four of the nine (44%) companies responding to this question, problem size exceeded 10,000 CPU hours. In the case of a filmmaker, a single large problem — presumably the processing of a feature-length film — consumed more than 10 million CPU hours. It is worth noting here that many industrial firms routinely tackle problems of varying size.

"There's no one answer. We have some large, medium, and rather small problems."

"Ours are greater than two weeks to solution."

"Very large!"

"Our large problems take 1,000+ CPU hours routinely."

"Rendering a film takes 10–100 gigaflops per frame, needs more than 300 terabytes of memory and more than 10 million CPU hours."

"Currently, we have problems in the several-CPU-hour range."

TABLE 9

Size of Current Problems

Q. How large are the largest problems you are solving today, in terms of CPU hours?

CPU Hours	Number	% of Respondents
<5	1	11.1
5–10	1	11.1
100	1	11.1
1,000	1	11.1
3,000	1	11.1
>10,000	4	44.4
Total	9	100.0

Source: IDC, 2006

Need to Solve Larger Problems

The answers to this question varied dramatically, ranging from 5x to 100,000x. For most of the firms (83%), however, currently unsolvable problems were in the 5–100x range (see Table 10).

Software Cost Limitations

More than half (54%) of the industrial end users said their ability to use HPC as aggressively as they would like for competitive advantage is limited by software costs (see Table 11). When the "at times" responses are added in, this figure climbs to 77%.

"Software costs are too high."

"Yes. Because of this, we sometime can't make a business case."

"Not really. We would likely use in-house software."

Hardware Cost Limitations

An even larger number of companies (69%, or 84% with "at times" responses included) are constrained by the cost of hardware (see Table 12).

"We also base hardware expenditures on the business case."

"Yes. To reduce our production cycles, we could use far more than we can afford."

TABLE 10

Need to Solve Larger Problems

Q. How much larger are the problems you'd like to solve?

Multiple	Number	% of Respondents
5–10x	7	58.3
100x	3	25.0
10,000x	1	8.3
100,000x	1	8.3
Total	12	100.0

Source: IDC, 2006

TABLE 11

Software Cost Limitations

Q. Are you limited by software costs?

	Number	% of Respondents
Yes	7	53.8
No	3	23.1
At times	3	23.1
Total	13	100.0

Source: IDC, 2006

TABLE 12

Hardware Cost Limitations

Q. Are you limited by hardware costs?

	Number	% of Respondents
Yes	9	69.2
No	2	15.4
At times	2	15.4
Total	13	100.0

Source: IDC, 2006

Other Critical Limitations

The outlines of the problem emerged more clearly when we asked about other critical limitations to the use of HPC. As Table 13 illustrates, it isn't just the cost of hardware and software that restricts the use of HPC for gaining competitive advantage in commercial markets. Even if money were no object, the capabilities of currently available hardware were judged inadequate by nearly half (46%) of the industrial firms, and software capabilities were lacking for about one-third (31%) of the respondents.

TABLE 13

Other Critical Limitations

Q. Are there other critical limitations preventing you from using HPC more aggressively?

	Number	% of Respondents
Hardware capabilities	6	46.2
Software capabilities	4	30.8
Problems don't parallelize well	2	15.4
Incompatible with others in company	1	7.7
Total	13	100.0

Source: IDC, 2006

For some companies, hardware capabilities are fine and software is the laggard; for other firms, the opposite is true; and for still others, both hardware and software fall short of their requirements. Much depends on the mix of problems each business needs to run. IDC knows from other recent research, for example, that the limited scalability of ISV application software is the main barrier for the automotive and aerospace industries.

The issue of hardware and application software scalability does not affect all industries or all applications equally. The challenge of increasing an application's scalability is closely related to the nature of the application, and ultimately to the mathematical complexity of the underlying technical problem, or set of problems, the application was designed to address.

At one end of the spectrum are certain "embarrassingly parallel" seismic analysis problems in the petroleum industry, for example, that can be neatly divided into distinct subproblems (e.g., single acoustic soundings). Each of the many subproblems can be run independently on a different processor of a high-performance computer, resulting in good scalability on many types of computer architectures, including more affordable clusters.

At the other extreme are challenging structural analysis problems and the emerging class of multidisciplinary (multiphysics, multiscale) problems, such as coupled fluid-structure interactions in the automotive and aerospace industry, that are not easily divisible and can be mapped onto only a small number of processors that must operate interdependently while the application is running. Current applications addressing problems like these have limited scalability and perform better on SMP (symmetric multiprocessing) computers and traditional supercomputers than on clusters. It follows from these examples that no single HPC computer architecture is ideal for all applications.

"Huge software costs."

"Software costs are too high."

"Very high software costs."

"Hardware growth is not being matched by software growth in scaling, performance, or business model."

"Hardware growth is not being matched by software growth in scaling, performance, or business model."

"The hardware is not there yet."

"The single image architectures [SMPs, traditional supercomputers] don't scale high enough, and our problems don't decompose for cluster architectures."

"Current hardware and software architectures aren't ready to take full advantage of massively parallel operations."

"High-performance hardware and software aren't available."

"The functionality is missing."

"We require compatibility with other groups in our company."

Need for a Petascale Computer

Three-quarters of the industrial firms (73%) said they could make use of a petascale computer (see Figure 16) to run today's crucial problems faster or to tackle next-generation problems of great competitive importance. This is an interesting finding, given that industrial users acquire substantially smaller versions of HPC computers, on average, than do leading government and academic users. But commercial computer purchases are more heavily dictated by budgets, and the fact that industrial firms have more modest HPC budgets than leading government users does not mean the companies have smaller ambitions for applying HPC.

Three-quarters of the industrial firms (73%) said they could make use of a petascale computer.

In fact, the comments accompanying this question cover a wide range of ambitions for using petascale computing capability, from running today's problems with greater resolution to achieving scientific and engineering breakthroughs.

"Yes, to do more extensive analysis."

"We could push the envelope with new science and more refined models."

"We could do calculations to define the parameters and do physics that we don't understand today."

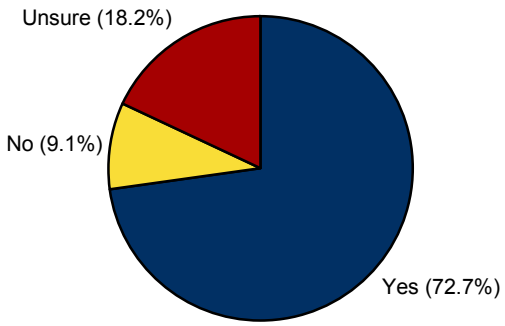
"We could do real-time rendering of full-resolution frames of CG [computer-generated] films. We could also do real-time simulation of clothing, hair, fur, feathers, fluids, etc."

"We could do a full engine simulation."

FIGURE 16

Need for a Petascale Computer

Q. Would you have use for a petascale computer?



n = 11

Source: IDC, 2006

Running Heterogeneous Problems

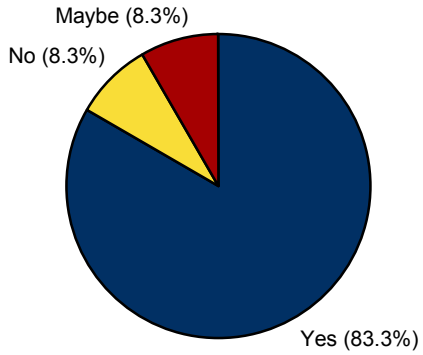
The vast majority of the industrial end users (see Figure 17) said they would (83%) or might (91%) use a petascale computer to run heterogeneous problems. IDC defines a heterogeneous problem, also called a multiphysics or coupled or multidisciplinary problem, as one that involves multiple scientific disciplines — for example, studying the complex interaction between the structure of an automobile and the fluid dynamics of air flow around it. HPC users are increasingly interested in solving heterogeneous problems — and successfully doing so could provide substantial competitive advantage — but currently available software and hardware systems are very limited in their ability to address the complexity of this type of problem.

The vast majority of the industrial end users said they would (83%) or might (91%) use a petascale computer to run heterogeneous problems.

FIGURE 17

Running Heterogeneous Problems

Q. Would you use a petascale system to run heterogeneous problems?



n = 12

Source: IDC, 2006

Explored Heterogeneous Problems with Your ISVs

All but one (91%) of the end users have already discussed their desire to run heterogeneous problems with their ISV suppliers (see Figure 18). This demonstrates that the desire to solve these problems is real and immediate, not simply futuristic. Unfortunately, ISVs by and large lack the ability to address heterogeneous problems today. As the comments below indicate, a few industrial firms are currently running simple heterogeneous problems, but for most commercial end users solving heterogeneous problems remains a more distant, sometimes frustrating goal.

"Yes. We've discussed coupled FEA/CFD models."

"Yes. We explored solid and fluid mechanics with our ISV and didn't reach a satisfactory conclusion. They said it was too much of an investment and I'd have to foot the entire development bill to address my problem. The ISVs won't take the risk."

"Yes, we are currently solving heterogeneous problems."

"Yes. We are running ISV codes coupled with our own internal software and routines."

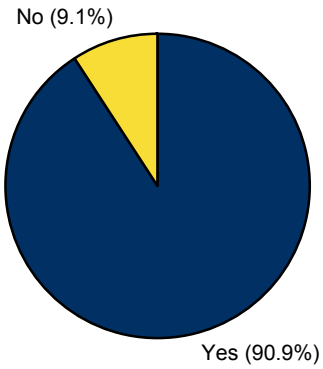
"Yes, for chemistry and flow."

"No. We have other, more pressing problems, and this level of complexity has a relatively small market."

FIGURE 18

Explored Heterogeneous Problems with ISVs

Q. Have you explored heterogeneous problems with your ISV suppliers?



n = 11

Source: IDC, 2006

Competitive Risks of Standard ISV Codes

One-third (33%) of the industry respondents replied that using standard ISV codes presents a competitive risk for their companies.

As Figure 19 shows, one-third (33%) of the industry respondents replied that using standard ISV codes presents a competitive risk for their companies, while the majority (67%) said it does not. For the minority who replied in the affirmative, the competitive risk is seen as an inability to differentiate the company's products. Here the assumption is that if everyone uses the same ISV software, everyone's products will be indistinguishably similar. In sharp contrast to this assumption, one of the respondents who saw no competitive risk underscored the human factor and noted, "It's how we use the software that gives us a competitive edge."

"Yes. Running industry-standard software limits the visual complexity that is possible [in making films] and limits our creative appetite."

"Yes. It gives our competitors the same capabilities as us."

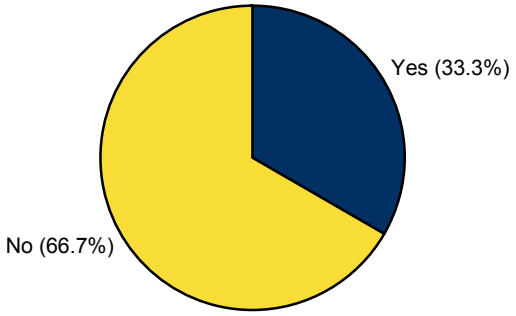
"No. It's how we use the software that gives us a competitive edge."

"Not using it risks slowing down our CAE development."

FIGURE 19

Competitive Risks of Standard ISV Codes

Q. Does running standard ISV codes pose a competitive risk for your company?



n = 12

Source: IDC, 2006

Views on Partnering

End-User Views of Potential Partnerships for Improving Applications

At this point in the study, we asked the industrial end users to respond to a more comprehensive set of questions regarding potential partners for collaborations to improve application software. Tables 14 and 15 compare the reactions to five partner types: national labs, universities, government agencies, business competitors, and ISV suppliers.

The "total" column, far right, shows that in general, positive responses (47%) outnumbered negative responses (20%) by more than two to one. Nearly half of the industrial firms had favorable views of external partnerships to improve application software. This represents a strong pool for forming collaborative relationships.

A minority of the respondents (27%) had at least "some concerns" about outside partnerships, however. Comments revealed that many of the concerns about partnering understandably had to do with maintaining control and competitive advantage. Some industrial end users wanted an assurance that they would gain competitive advantage through the partnership, such as from exclusive use of the results for a specified period, or from rights (exclusive or shared) to any new intellectual property. Others were more concerned that they might lose competitive advantage by sharing their knowledge and technologies with outside organizations. Still others simply wanted to be assured that the partnerships would really improve their simulation capabilities.

"We'd want exclusive use of the results for a period of time."

"We'd expect shared risk, with joint ownership of the intellectual property or credit for the IP we contribute."

"We're open to partnerships but would want to maintain our competitive advantage in our core industry."

"We'd want a partnership where the scope, goals, and methods are agreed upon in the beginning and we are an active partner."

"Ones that will improve our ability to conduct design analyses."

"We'd want a partnership where the scope, goals, and methods are agreed upon in the beginning and we are an active partner."

TABLE 14

End-User Views of Potential Partnerships for Improving Applications (Number of Respondents)

Q. Please give us your views of various potential types of partners for collaborating with you to improve application software.

	National Labs	Universities	Government Agencies	Competitors	ISV Suppliers	Total
Positive	6	6	5	3	8	28
Some concerns	3	4	4	5	–	16
Neutral	–	–	–	1	1	2
Negative	2	2	3	2	3	12
Not sure	1	–	–	1	–	2
Total	12	12	12	12	12	60

Source: IDC, 2006

TABLE 15

End-User Views of Potential Partnerships for Improving Applications (% of Respondents)

Q. Please give us your views of various potential types of partners for collaborating with you to improve application software.

	National Labs	Universities	Government Agencies	Competitors	ISV Suppliers	Total
Positive	50.0	50.0	41.7	25.0	66.7	46.7
Some concerns	25.0	33.3	33.3	41.7	–	26.7
Neutral	–	–	–	8.3	8.3	3.3
Negative	16.7	16.7	25.0	16.7	25.0	20.0
Not sure	8.3	–	–	8.3	–	3.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: IDC, 2006

Partnering with ISV Suppliers

Among the partner types, ISV suppliers elicited the highest percentage (67%) of positive responses (refer back to Tables 14 and 15) — although they also scored comparatively high in the negative response category (25%). None of the respondents said they had "some concerns" or were "not sure" about working with ISV suppliers. In other words, respondents appeared to know what to expect from ISV collaborations.

"We'd had very good experience across our industry and will continue doing this."

"For the most part, it's problematic. They want me to assume all the risk for development."

"They're focused on the commodity space, not the future of computing. Getting a larger number of less-sophisticated customers is their goal."

Partnering with National Laboratories and Universities

National labs and universities were tied (50% positive responses each) as the second-most-popular potential partners for collaborations related to application development. These two categories also had the same number (17%) of negative responses. The two chief complaints about these partner types were that they tend to overestimate the value of their own ideas and failed to understand commercial market requirements (e.g., ease of use, functionality, intellectual property protection).

"We love working with labs."

"I'm concerned that the labs will see it as a scientific experiment, while we are faced with time-critical real world deliverables."

"We have limited experience working with labs on competitive technologies."

"In our experience, relationships with universities take time to get started. We usually enter into one-to-one agreements."

"Working with universities is okay for research projects."

"Collaborating with universities is problematic. They're obsessed with obtaining value and have a disproportionate idea of the value of their ideas. They don't get the concept of commercial value in the marketplace."

"I worry about the IP risk in working with universities."

Partnering with Government Agencies

Government agencies were also viewed favorably (42% positive responses), though not as favorably as ISV suppliers, national labs, or universities. Where agencies were concerned, the primary fear was that lengthy bureaucratic approval processes ("red tape") and slow working methods might seriously impede progress.

"*Our experience with agencies has been very positive."*

"Positive."

"We have some experience, with a mixed bag of results. It's difficult to generalize."

"We have little direct experience. We've heard from other parties that agencies appear to have conflicts in their mission about collaboration with industry. There may be too much paperwork and red tape."

"They're generally slow and laborious, at least based on our experience. There's too much regulation and too little action. The process and paperwork would likely make it difficult to succeed by our standards."

Partnering with Others in Your Industry

Easily the least-favored type of category for potential collaboration consisted of "competitors in your industry," although even here there were some interested parties (25% positive responses). The comments showed that at least some industrial end users have had successful collaborations with direct competitors. Most of the end users, not surprisingly, viewed the prospect of sharing knowledge and technology with competitors askance.

"We have done so successfully for several years."

"I'd love to work with a noncompetitive automotive or aerospace company but am very wary of our own industry."

"These are the areas of competitive advantage. It is unlikely any of us would share results with enough specificity to be useful."

"Our experience doing this is mixed: some good, some not so good."

"We have done a couple of very large shared projects with our competitors in the area of large longer term R&D that no single company could afford to do by itself."

Collaborating with Non-U.S. Partners

To help complete the picture, we asked the industrial end users whether they had concerns about working with non-U.S. partners. A small majority (54%) replied yes. Comments highlighted the need to safeguard sensitive information in dealings with non-U.S. collaborators (see Table 16).

"We already do. We just need to be aware of sensitive subjects and information."

TABLE 16

Concerns Regarding Working with Non-U.S. Partners

	Number	% of Respondents
Yes	7	53.8
No	6	46.2
Total	13	100.0

Source: IDC, 2006

FOR ADDITIONAL INFORMATION

For additional information, go to:

www.compete.org

www.idc.com

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