

A large yellow Volvo articulated dump truck is shown working at a quarry. It is dumping its load onto a conveyor belt system that transports aggregate. The background shows a quarry with piles of aggregate and some industrial structures.

NOT ONLY ARE TWO KENTUCKY CONTRACTORS'
ARTICULATED DUMP TRUCKS WORKING HARD HAULING
AGGREGATES ON HIGHWAY PROJECTS, THEY ARE ALSO
HELPING AT THE QUARRY WHERE THE STONE COMES FROM.

BRIAN O'SULLIVAN &
RODNEY GARRETT explain

Photography: Rodney Garrett

Kentucky Favorites

Where would Americans be without their highways? Their love of the automobile would be consigned to the garage; there would be no 'road movies'; a good proportion of their rock & roll would have lost its subject matter and McDonalds would be at a bit of a loss as to where to put the next 'diner'.

Luckily, the good ol' US of A highway is alive and well – and thanks partly to TEA-21, the federal government's massive road building program, the American road network has never seen so much investment. In fact, highway development has consumed so much aggregate in recent years that to ensure a ready supply at reasonable cost, specialist road contractors are increasingly vertically integrating into the quarrying business. Such is the case at Bourbon Limestone, a quarry operation in the Kentucky town of Paris. The company is a joint venture between The Walker Company and Hinkle Contracting Corporation, both highway and heavy construction contractors serving the eastern half of Kentucky.

At first, quarrying at Bourbon Limestone was not difficult, the 20m (65ft) deep formation of Lexington limestone lay directly beneath the overburden. However, half a century of quarrying this stone has all but exhausted these reserves – and the rock directly below the quarry floor is not economically feasible for aggregate production.

There is another layer of limestone in the quarry that is viable for extraction. Unfortunately though, it is 82m (270ft) below the current quarry floor, leaving the company with the choice of either closing the quarry once the surface layer rock reserves are depleted, or going under-ground to mine these lower deposits of Camp Nelson limestone.

As Camp Nelson limestone has good blasting and crushing properties, making it suitable for producing Superpave aggregates, and most Kentucky road paving projects call for Superpave, Bourbon Limestone opted to go

subterranean. The first step was to consult with specialists about the mine's design and construction, and then construction of an access road leading to the mine's portal began.

Access to the mine entrance required a 378m (1,240ft) long road with a downward slope of 14° (25%). This road starts at the existing quarry floor and descends to the portal, 94m (310ft) below.

A total of 841,000m³ (1.1 million yd³) of rock was excavated to build the access road. At the start, an excavator and two 90t (100 USton) payload-capacity, rigid-frame trucks were used to transport the rock. Unfortunately, while rigid-frame haulers are often good performers in such applications, in this instance, on such an extreme gradient, the rigid-frame trucks proved unsuited to the task.

In the course of hauling the first 382,000m³ (500,000yd³) of excavated rock, both trucks' transmissions experienced problems. One had to be replaced and the other rebuilt.

Tim Hatton, quarry manager, says fully loaded rigid-frame trucks are not designed for constantly negotiating such extreme gradients. In addition, it was difficult to maintain a high standard of surface on this steep grade, meaning that the terrain of the mine access road was rough during its construction. To make matters worse, the road would become extremely muddy during rainy periods. The end result was one of poor production performance from the rigid-frame haulers.

The issues encountered with the rigid haulers prompted the company to try new Volvo articulated haulers to carry out the remaining 458,000m³ (600,000yd³) of materials yet to be excavated. It was decided that these haulers, once the access road was completed and the excavation of the mine begun, could also be used as the muck-out hauling system.

"We reasoned that Volvo haulers could be the solution to our problems as we already had some good experiences using them on construction projects," explains Tom Hinkle, VP of Hinkle



Contracting. Hinkle uses two A35 model Volvos at another quarry for transporting blasted rock down a steep haul road with a 20% gradient. Each hauler has clocked up 15,000 operating hours on this mountain quarry, and each with a minimal downtime. The Volvo haulers have operated so cost-effectively in these examples of extreme downhill applications, as well as on general construction projects, that both Hinkle and Walker felt that they would be a good bet for uphill hauling too.

Their reasoning proved correct – "performance at the Bourbon Limestone quarry has been excellent," says Walker Co's Arthur Walker III. "We have used four new Volvo A35D trucks here with practically no downtime during their 8,000 hour operating times. Since the start, we only had to replace a couple of differentials," Walker continues.

Production efficiency at Bourbon has also been good. At cycle distances of up to 1,219m (4,000ft) (756m/2,480ft of which is going up and down the steep grade) the haulers' cycle times were

between eight and nine minutes. This includes loading and dumping. Typically, a loaded truck negotiated the 378m (1,240ft) long access road in three minutes.

The company has already mined and hauled away enough rock to install a new 1.2m (48in) x 421m (1,380ft) long conveyor for transporting the primary-crushed rock from the mine to a new tower-mounted triple-deck screen, 421m (1,380ft) away. Even though the Volvo haulers have been released from their muck-out hauling duties, they are still not going to be retired from this project. They will now be used for the next year to haul the blasted rock from the mine headings to a jaw crusher installed near the portal.

"WE REASONED THAT VOLVO HAULERS COULD BE THE SOLUTION TO OUR PROBLEMS, AS WE HAD ALREADY HAD SOME GOOD EXPERIENCES USING THEM ON CONSTRUCTION PROJECTS"

Ultimately, larger-capacity rigid-frame trucks will take over the underground task of hauling the blasted rock from the headings to the jaw crusher. Currently this is not possible as the first advancement of headings have only an 8.5m (28ft) head clearance. A big rigid frame hauler needs more headroom for the body to fully tip. With this low roof, only the likes of an articulated hauler can dump and still have a superior payload capacity when compared to highway end-dump trucks. It will not be until a 3.6m (12ft) cut is made to lower the mine's floor that the larger-capacity rigid-frame trucks will replace the articulated trucks.

The story doesn't end there; Art Walker says his company will continue to use them on construction and excavation projects. "Trucks this versatile will never sit idle for long," he says.



No Compromises

BRIAN O'SULLIVAN explains

WHAT WILL VOLVO'S CONSTRUCTION MACHINES LOOK LIKE IN THE 2020s? A TEAM OF DESIGNERS HAS COME BACK FROM THE FUTURE TO SHOW US WHAT TO EXPECT.

Industrial designers are a troubled bunch. They constantly have to balance the Possible with the Practical when creating the products that come to market. The outcome is ultimately a compromise between the two factors. And it can be very frustrating for designers, poor things – that's why they always wear black. But their serious faces break into wide smiles when they are given free rein to indulge their creativity to the full – and the outcomes can be truly startling.

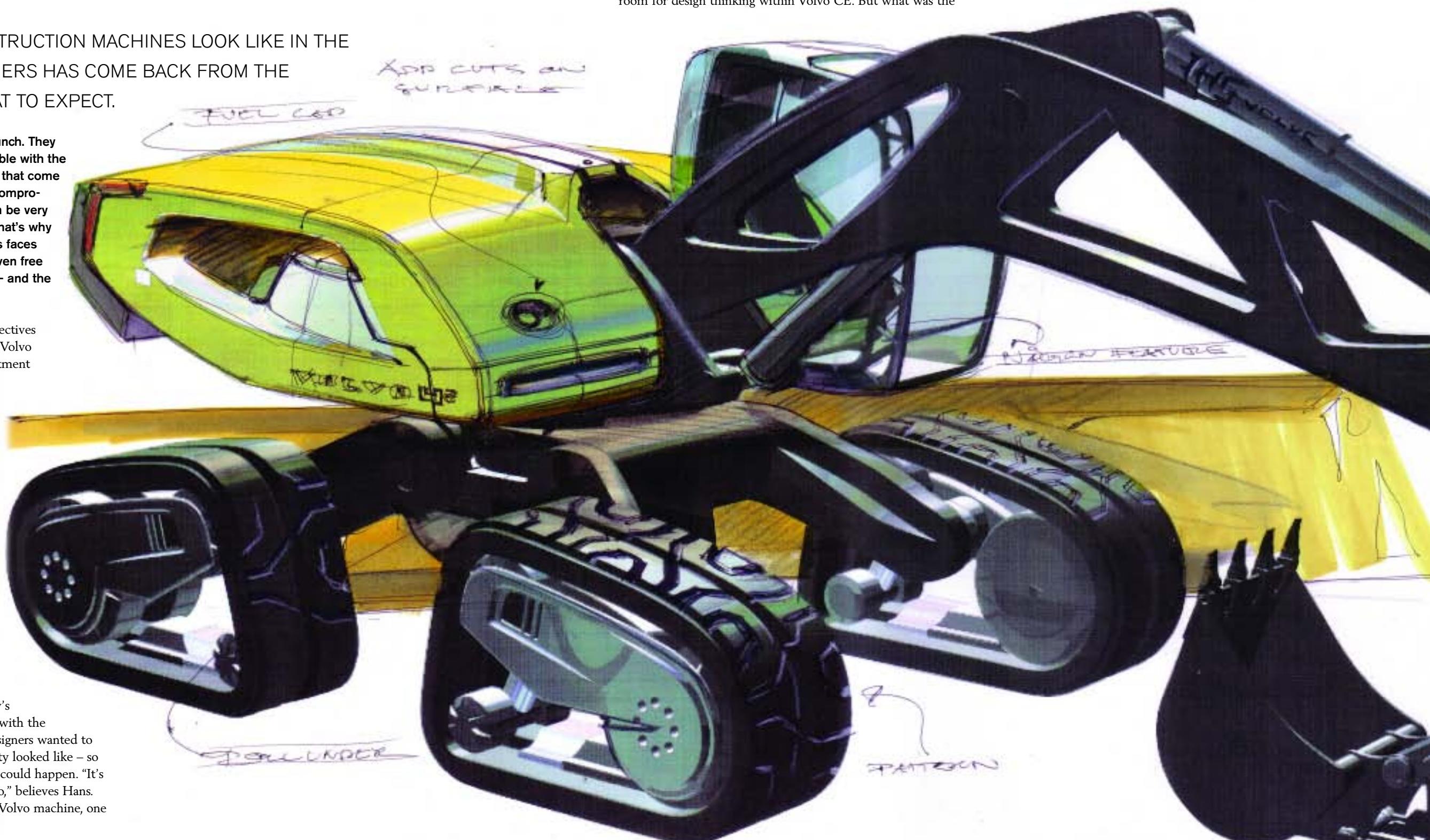
Such is the case at Swedish firm Perspectives Design, part of the Epsilon Group, whom Volvo Construction Equipment's research department charged with the task of looking into the future and hypothesising what Volvo Construction Equipment might look like in the 2020s. Managed by Robert Bourghardt and overseen by chief designer Hans Zachau, the team translated the main specifications received from Volvo CE research and advanced engineering departments into radically new solutions. Some of these innovations probably won't make it off the drawing board, but others could become reality in the near future.

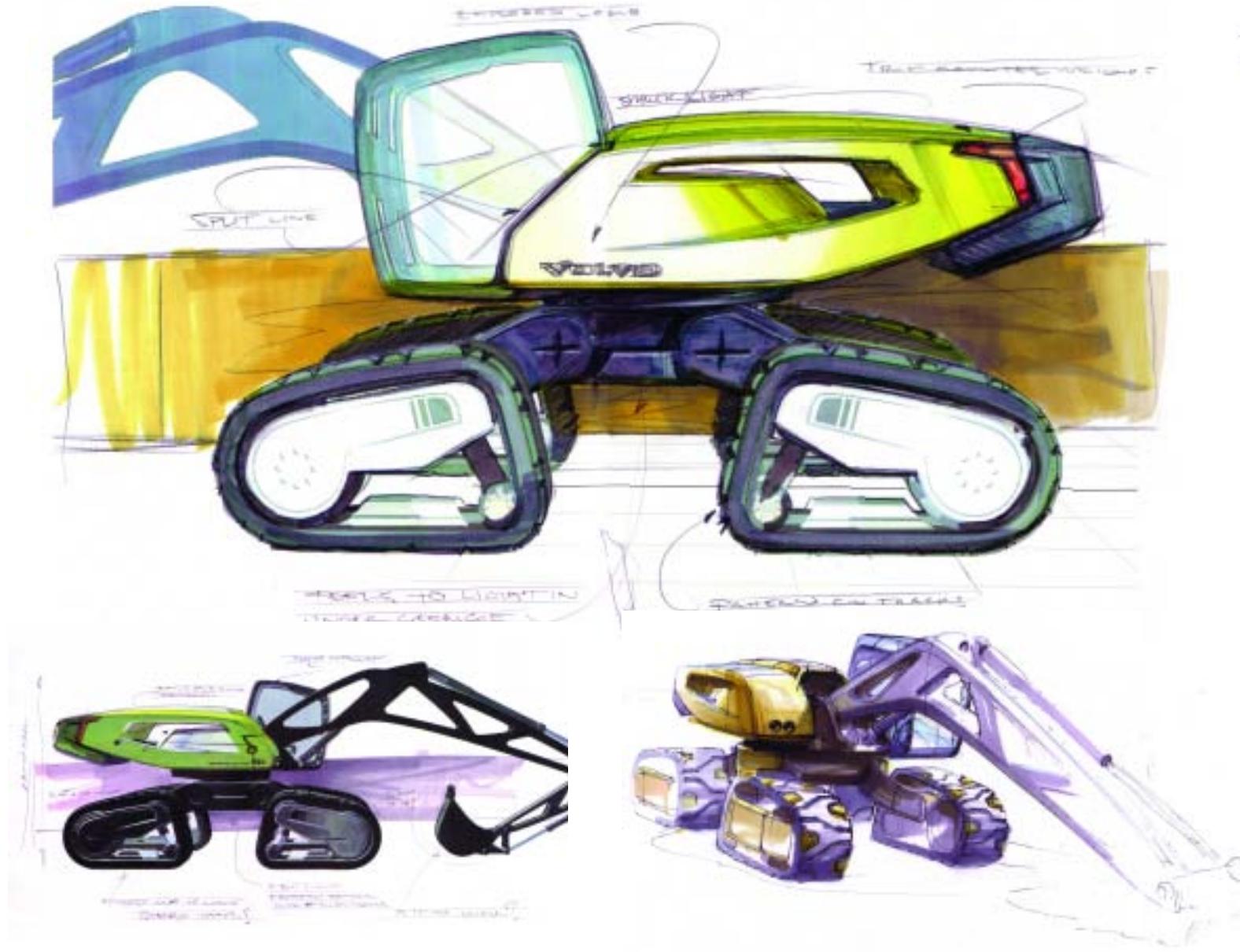
The team talked to operators to find out what they would like to see in future machines and to the engineers in the product divisions at Volvo. Then they consolidated their ideas with the company's Advanced Engineering unit. The dialogue with the technicians was important because the designers wanted to know what the potential engineering reality looked like – so they could design an excavator that really could happen. "It's very important that we tie it back to Volvo," believes Hans. "It's important that we demonstrate it's a Volvo machine, one

that reflects Volvo's core values. Otherwise it doesn't connect to the present product range – and that's key in concept vehicles: people must be able to make the connection."

The study was used to create a 'wow' factor at the Bauma¹ trade show – but if it were left just as a marketing tool it would be an opportunity missed. Happily though, the intention is to incorporate the study into Design Lab, a virtual discussion room for design thinking within Volvo CE. But what was the

main learning of this study? "We learned not to be scared of new technology and radical concepts," says Hans. "Construction equipment is quite a conservative business – but there are lots of possibilities. We can't promise that by 2020 all our ideas will have come true. We had to guess sometimes – that's the whole idea, to imagine possible outcomes. But if only 10% of what we have thought about ends up in future machines, then we will really have achieved something!"



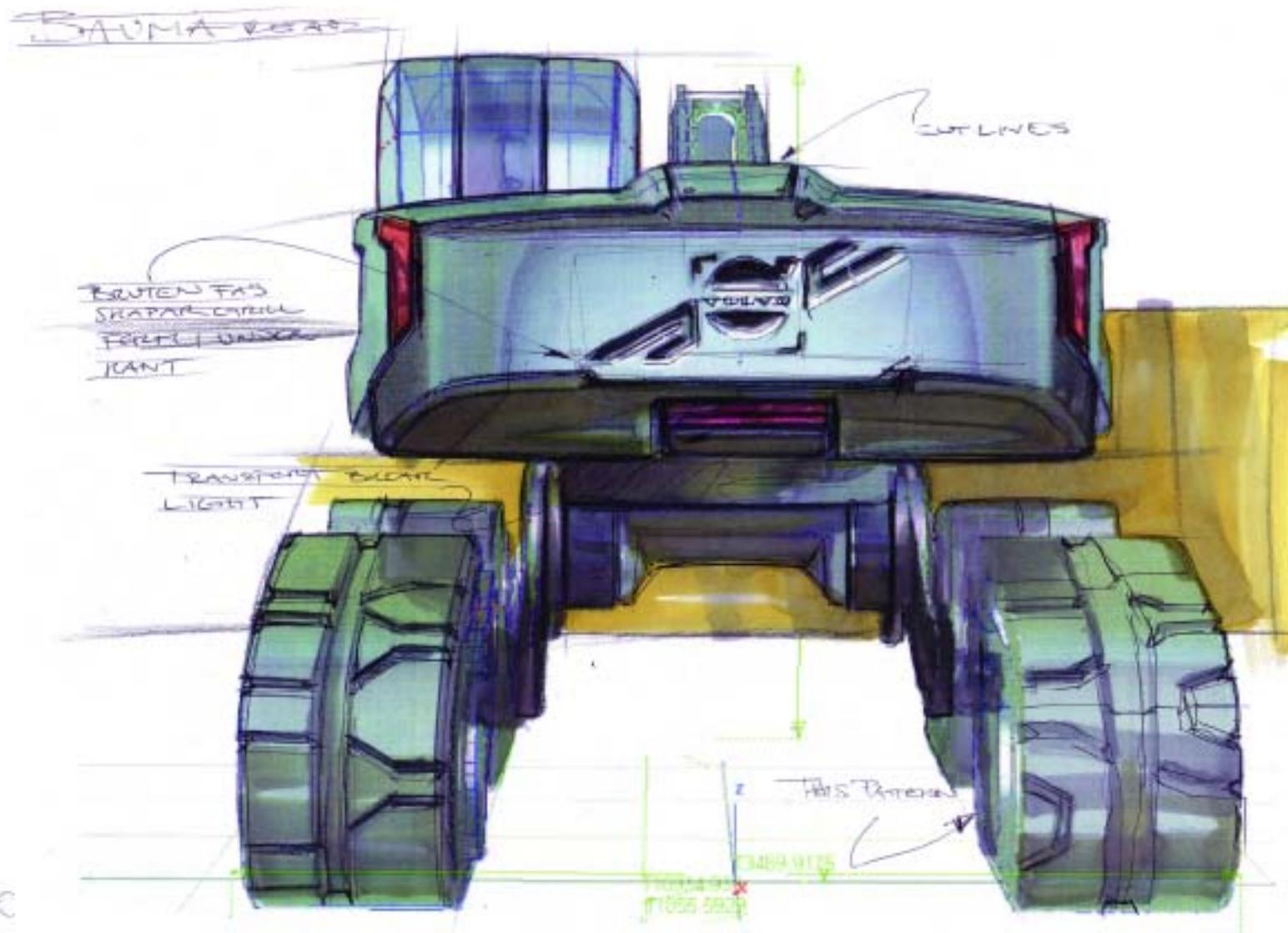


Appearance: The final design of the excavator is a mixture between space age and primordial, like a prehistoric moon buggy. "The animalistic look is intentional," says chief designer, Hans Zachau. "It should be efficient, lean and hungry to dig. Purposeful and a little mean looking. But we have to remember that it's a Volvo machine and therefore it still has to reflect its core values of Quality, Safety and Environmental Care." The machine is still recognizably an excavator, and the design updates current concepts of boom, cab, tracks and superstructure – but in an innovative way. The familiar Volvo logo and color scheme ties the design back to the current machines. The omission of hydraulics makes for a cleaner looking machine that means business.

Hydraulics: The introduction of electricity could also do away with some of the hydraulics. Some systems that are

currently hydraulic could be converted to electric motors. Notice how hydraulic cylinders have been removed as much as possible and hydraulic piping abandoned. This would obviate the need to circulate oil all over the machine.

Boom: The central concept was to make a light boom – because everything in weight on the boom is lost in capacity for lifting or digging. The see-through lattice allows visibility through the boom, aiding safety by reducing the operator's blind spot caused by solid metal booms. While current steels would struggle to cope with the large forces imposed on the boom, the designers are expecting a new generation of high strength steels to be available, that could make this a design possibility. Hydraulics have been removed from the boom as much as possible to reduce clutter and keep the look of the machine as clean as possible. The main cylinder has been hidden



within the boom. Not much room for contractors' name stickers on that boom though!

Engine: The future machines may no longer use diesel engines. The designers toyed with the idea of using gas turbine engines but settled on the idea of fuel cells. Fuel cells convert a hydrogen's energy into usable electricity and heat – without combustion. Because hydrogen reacts with oxygen to produce electricity, it is the optimal fuel to use, as its only emissions are water vapor and heat. They are like batteries that don't run down as long as you keep feeding them hydrogen. They are currently in the development stage but it has been calculated that to power an excavator, a fuel cell the size of two normal suitcases would be needed. This frees up a lot of space on the superstructure where the diesel engine would normally sit – hence the machine's ability to have such a large cutaway

section. The engine acts as the machine counter weight, which moves all the time to compensate for the forces on the boom. By moving it towards the center of the excavator, it could be made small for transport, moving it right out would give maximum stability. (Zero swing or large swing.)

Undercarriage: The adoption of four tracks is to make them more wheel-like. When driving on rough ground, traditional tracks 'tiptoe' and the contact area is quite small. Four tracks have a much higher contact area with the ground, aided by independent suspension to each track, suspended via a swing arm from a central pivot. Each track has a separate wheel motor, which can brake, accelerate and even turn. On traditional tracks you either brake or accelerate, left or right. Tracks will also use a non-metal rubber-like material that can cope with high abrasion surfaces. The four tracks can be moved



to form a traditional two-track appearance to distribute the weight better when on soft ground. This system (powered by electric motors) can also be used to extend the tracks for working or contract them for transportation.

Main bearing: the juncture between the undercarriage and superstructure would eschew the current arrangement of a large roller bearing. Instead the concept excavator hovers on an electro-magnetic field. The advantages of this are that there would be zero friction and high-speed turning of the superstructure. (The boom forces could be compensated by varying the magnetic field.) While a clever idea, one area of concern is that by having so many electrical motors in a small area, a too-large electro-magnetic field would be created.

Cab: The cab on the concept excavator is cantilevered to improve all-round visibility. But it can also tilt the cab, move it away from the machine to improve visibility (as some waste handling machines already do), or be left on the ground entirely. This latter attribute is for operating the excavator remotely, such as where there is a high level of radioactivity - or if the machine is working underwater. "In the morning, the cab comes down to meet the operator," says chief designer Hans Zachau. "It then opens the door and says 'hello, how are you today?'" 

"IT'S IMPORTANT THAT WE DEMONSTRATE THAT IT IS A VOLVO MACHINE, ONE THAT REFLECTS VOLVO'S CORE VALUES"



¹ The team's sketches, animations, virtual reality – even a 1:7 scale model – could be seen at the Volvo stand at Bauma.

A Heart of GOLD

VOLVO SPIRIT'S EDITOR investigates

THE WEST AFRICAN STATE OF GHANA IS ONE OF THE WORLD'S LEADING PRODUCERS OF GOLD AND MANGANESE; IT IS ALSO ONE OF VOLVO CONSTRUCTION EQUIPMENT'S MOST IMPORTANT REGIONAL MARKETS.

Situated on the Gulf of Guinea between Ivory Coast and Togo, Ghana was known during the British colonial period as the Gold Coast. As its former name indicates, Ghana has a long tradition of gold mining dating back almost 2000 years to a time when Egyptian traders would regularly cross the Sahara in order to trade spices and manufactured goods for the valuable metal.

Today, Ghana's mining industry also removes sizeable deposits of silver, iron, bauxite and diamonds, and provides the backbone of the Ghanaian economy. The recent introduction of more favorable exploration laws has encouraged further expansion of the mining sector, attracted more overseas investment and expertise, and of course allowed Volvo CE to build a diverse business. A tour around some of Ghana's mines and the important role played by Volvo equipment is evident. "Along with Volvo construction equipment, we are today providing machines and expertise to a wide range of mining applications in Ghana," explains Angelo Massimino, Executive Director of Multi-Tech, the local representative for Volvo CE, Volvo Truck and Bus and Volvo Penta Engines.



Gold mining

The Bonte Gold Mine is located in the Ashanti Region of central Ghana, and consists of alluvial gold deposits located along a river floodplain. As the ore deposits rest on bedrock overlain by between 3 and 6m of overburden, the mine is a free dig operation involving a fleet of Volvo equipment.

According to Doug Mills, Operations Manager for Bonte Gold Mine, the mine originally rented Volvo articulated haulers in 1992. They were so impressed with the overall performance that they eventually bought a fleet, which today consists of eight A35C haulers, seven Volvo FM12 8X4 19m³ tipper trucks, five Volvo EC650 excavators and four Volvo wheel loaders. Today approximately 90% of Bonte's equipment is Volvo.

"The Volvo A35C haulers do one hell of a job, in the toughest and muddiest conditions," comments Kurt Speta, Bonte Goldmine's maintenance manager. "I didn't have any experience of Volvo equipment before I worked here, but as we get at least 90% availability from all of our machines, they've certainly impressed me!"

BONTE IS A GREEN FACILITY WITH ITS OWN NURSERY OF TREES AND SHRUBS THAT ARE USED TO RE-PLANT THE MINED AREAS

The gold mining at Bonte is a 24-hour operation involving the Volvo excavators clearing away overburden and then the gold ore being loaded onto articulated haulers. The ore is then hauled directly to the on-site processing plant or nearby stockpiles. At the processing plant, the ore is deposited into an ore hopper, three L180Ds and one L70D wheel loader assist in pushing it further into the hopper where a high-pressure water jet breaks up clay clumps and begins the slurry formation.

The resulting ore slurry is then pumped through a cyclone to remove additional lightweight material and finally passes over a sluice-box where gold particles are

recovered. The gold concentrate is moved to the gold processing room where additional processing results in an 85% gold concentration.

Bonte is a green facility with its own nursery of trees and shrubs that are used to re-plant the mined areas. This 'back to nature' program has the backing of the Ghanaian Government and eventually Bonte will be returned to a forested area.



Limestone Loading

Based at Takoradi, the major port city in the Western Region of Ghana, Carmeuse Lime Products Limited supplies the gold mining industry of Ghana with lime mainly used in the biological oxidation process.

Limestone is imported from France and Belgium, as the local limestone was found to be of insufficient purity for gold extraction.

The facility's finished products are crushed quicklime, and fine and dense hydrated lime, which are either delivered to customers in 35-ton bulk tankers or in bulk bags.

At Carmeuse, the Volvo wheel loaders are utilized for a number of tasks around the company's yard, including the unloading of shipments in the port.

To unload a ship, a L90D is lowered into the ship's hold where it prepares stockpiles for the shore-based grabs. While the grab is unloading, the L90D has approximately two minutes to ready the next stockpile before the grab returns into the hold. A typical ship hold is 30m x 50m, so working in one requires a good turning radius explains Martin Hiles,



"THE LEVEL OF LIGHT INSIDE A SHIP'S HOLD IS LOW, SO THE GOOD VISIBILITY OF THE L90D'S CAB IS EXTREMELY IMPORTANT"

Operations Manager of Carmeuse Lime Products, and this is one of the reasons the L90Ds have proven to be ideal.

"The level of light inside a ship's hold is low, so the good visibility of the L90D's cab is extremely important," adds Mr. Hiles.

"From the loading of imported limestone used in gold extraction, to the hauling and loading of gold ore, Volvo equipment is increasingly visible in all mining sectors of Ghana," sums up Mr. Massimino. 



LIFE THROUGH A LENS

DAN WADDELL investigates...

Photography: Julian Cornish Trestail



TONI HAGELBERG IS NOT THE TYPE TO BE FAZED BY A NEW CHALLENGE. WHEN HE LEFT HIS JOB AT ABB TO JOIN VOLVO CE FOUR AND A HALF YEARS AGO, TO HEAD UP THE SOFTWARE AND ELECTRONICS DIVISION IN ESKILSTUNA, HE ADMITS HE KNEW ABSOLUTELY NOTHING ABOUT ELECTRONICS – AND EVEN LESS ABOUT SOFTWARE.

"I had been an engineering manager developing hydropower generators, working with huge machines weighing 2,000 tonnes, so it was a real change. I had to run the department from day one and I had to learn from scratch. It took me a full year before I truly felt comfortable about my role," he says, laughing now about what must have been a daunting experience.

Yet Toni, 38, had no hesitation in accepting the job when it was offered to him, because a career at Volvo had been a long held-ambition. As a boy growing up in Skepptuna, 50km north of Stockholm, he lived near a farm and was fascinated by heavy machinery, grabbing every opportunity to drive Volvo BM tractors.

Then his interest spilled over into his years as a mechanical engineering student at Linköping where he completed his masters' thesis on Volvo machines.

As manager for software and electronics development in Eskilstuna, Toni set about trying to improve collaboration between the two "software and electronics" departments in Eskilstuna and Korea, which previously had existed independently, each focusing on their own product line.

This initiative led Lorenzo Terreno, Vice President Product Portfolio and Advanced Engineering, to ask Toni in

March 2003 to run the new Volvo CE commonality program.

Put simply, the program seeks to standardize components across the whole Volvo CE line. Over the years, the company has grown considerably as it purchased other companies. And every acquisition added new parts to the catalog and new names to the supplier base.

"What we are trying to do is establish as many things in common among Volvo products as is possible," Toni explains. "Our aim is to establish a

range of 'platform parts', common among all the product lines."

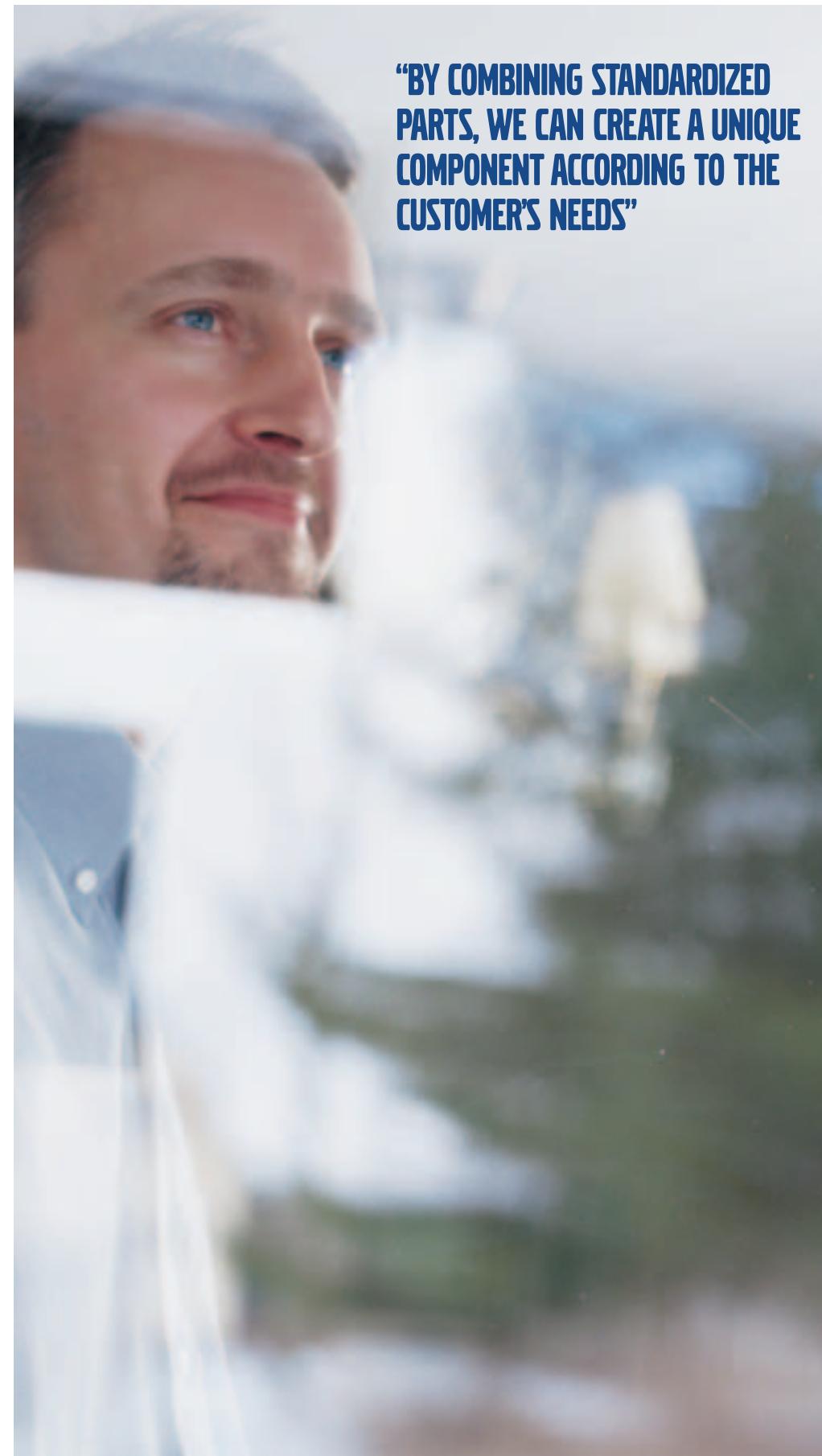
It is down to Toni to coordinate the program, overseeing the work of seven

different teams. Each team consists of engineers from wheel loaders, excavators, graders, articulated haulers and compact equipment; bringing together experience and resources from everywhere in the world and from many different applications. "Such diversity does not make things easy, but it's a lot more powerful," Toni admits.

"The program is new and we really did not know the best way to run it, so we have had to learn as we progressed and get people thinking about issues of commonality," he admits.

"But I like that it is new, and that we had to find a way to make it work. It has big potential. I believe it can be a

"WE ARE TRYING TO ESTABLISH AS MANY THINGS IN COMMON AMONG VOLVO PRODUCTS AS IS POSSIBLE"



"BY COMBINING STANDARDIZED PARTS, WE CAN CREATE A UNIQUE COMPONENT ACCORDING TO THE CUSTOMER'S NEEDS"

profitable program. But there are also huge expectations that we get some results, so there is pressure. But that is also interesting."

Much of the program's benefits will not be seen until the next generation of products. While the program will have some economical advantages for Volvo, it is the benefits to the customer that animates Toni, and he looks forward to receiving their opinions.

"The biggest advantage for customers involves spare part availability, consumables such as air filters, fuel filters, fuses, bulbs, components such as that," he says. "If those are in common, then it is much easier for the dealer to have them in stock, or for bigger customers with larger fleets to have their own stock, which means better availability."

The program also works toward using similar safety standards and man-machine interfaces across product lines, to make it easier for operators to operate and technicians to service different Volvo CE products. A first step in this direction had already been taken with the common service- and diagnostics tool VCADS Pro, which was introduced in 2000 and is also used on Volvo trucks and buses.

"And there is flexibility for the customer. For example, by combining standardized parts, we can create a unique component according to the customer's needs. We call this modularization or the 'lego' approach. One example of this will be the operator seat for next generation products."

Running the program is involving work. Away from the office, however, Toni's focus is on his family. His wife Lena works part-time for a travel agent, and his three children, Alicia, 9, Joel, 7, and two-year-old Agnes, take up most of his time. Though even at home, he can't stay away from ambitious projects – trying to build a sauna is his latest venture.

Your comments, suggestions or questions are welcome at toni.hagelberg@volvo.com