MA7300-P - Morgan Motor Company: Maximizing Workflow Efficiency.

Jon Wells – Senior Designer, Morgan Motor Company.

MA7300-P This talk presents a case study on the evolution of the design process within a historically traditional company. It will cover how Morgan uses modern design and visualization technology to maximize design efficiency while integrating with traditional workflows. This talk is led by Senior Designer Jon Wells and focuses on the project development of the critically acclaimed Morgan 3 Wheeler.

Learning Objectives
This class will demonstrate:

- How to efficiently deploy sophisticated technologies in a low volume production environment.

- Learn how Autodesk® Alias®, Autodesk® Showcase®, and Autodesk® 3ds Max® were used together in the design and visualization of the new Morgan 3 Wheeler. Understand how visualization assets and processes can be extended to multiple functions within a company. For example; marketing and sales.

- Connect Autodesk® Alias®, Autodesk® Showcase®, and Autodesk® 3ds Max® software together in a design and visualization pipeline using the best capabilities of each application.

About the Speaker

Jon Wells is the Senior Designer at the Morgan Motor Company in the UK. He was tasked with integrating digital 3D technology into the previous design / build workflow. Since he began working with Morgan in 2007, Jon has had a crucial role in the design of the Aero SuperSports, Aero Coupe, Morgan 3 Wheeler, and the new Plus 8. He has helped facelift the Classic Morgan car range and worked on the development of Morgan LifeCar and EvaGt concept vehicles.

Before joining Morgan Jon worked with Land Rover and TVR, whilst completing a four year Automotive Design from which he qualified with a first class degree with honors. His responsibilities within the company now encompass all aspects of aesthetic design; brand and product design, marketing campaigns and vehicle design.

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Talk Outline

Setting the scene:

- Background
- Morgan Motor Company – History and Growth

The Cars and how they are made:

- The Cars
- The manufacturing process and materials
- Environmental Consideration

The Challenges and benefits of a small business workflow:

- Small business and innovation
- The Development Team
- Collaboration

The Impact of digital design technologies:

- Pre Digital Design

The Morgan 3 Wheeler (from concept to completion in 18 months)

- The Intention
- The Design Process (Sketch work through to production)
  - Influence
  - Sketch work
  - Package and reference files
  - Surfacing
  - Evaluation
  - Zero Cost Sign off
  - Concept launch
Autodesk applications beyond vehicle design:

- Promotional material
- Production Design
- Bespoke and Concept Cars
- Customer Specification
- Show Stand Design

The Future:

- Project forge – Faster Efficient Modeling
- Advanced Visualisation
- Display, Process, Manage
- Morgan – What’s Next?

(2011 EvaGt –Concept car)
Setting the scene.

- **Background**

  This case study demonstrates how modern technology and software can rapidly aid the development speed and everyday responsibilities of small team designers and crucially small businesses as a whole.

  This unique case study highlights the contrast between the traditional nature of Morgan’s Classic car manufacture and the integration of latest design and realization technologies from Autodesk.

  The link between traditional and modern follows through to the physical car themselves. Each one is entirely handmade. However the cars feature the very latest in chassis, engine and drivetrain technologies, along with subtle driver assists, passive safety systems and superplastic aluminum forming techniques.

  Your speaker’s introduction to the company was due to his ability to implement digital design capability that enabled the company to become more time and cost effective in the realization, manufacture and design of their products. Modern design processes also encourages the ability to innovate within a small team. This is paramount to the success of any small business, especially at Morgan where the nature of the handmade manufacture is time consuming.

  *(2012 Morgan range)*

- **Morgan Motor Company – History and Growth**

  Morgan Motor Company was founded with the iconic production of the Morgan Three Wheeler. The brilliant yet simple design of by Henry Morgan in 1909 resulted in it becoming one of the most successful cars of early day motoring.

  Henry Morgan worked in a small garage at the foot of the Malvern Hills in the Cotswolds, just yards from where the factory is still located today. The intention was for a vehicle powerful enough to travel up and down the hill side to his home and be produced economically.
The principle of fitting a powerful engine to a lightweight chassis has remained paramount to the company through three generations of Morgan ownership, to today. The 3 wheeler has continued to evolve with many specifications and was quoted as ‘…being able to provide freedom to the masses.’

The racing 3 wheelers were so fast that they were required to start a whole lap behind their 4 wheeled competitors whilst racing at legendary British circuits like Brooklands. Morgan quickly started to successfully sell overseas, with large dealerships established in Europe and specifically Paris.

(The evolution of the Three wheeler)

The cars high performance and credibility on the race track soon attracted the attentions of the affluent and the Morgan brand soon became considered to be fashionable. The resounding success of the first 4 wheeled Morgan in 1936 has resulted in the Morgan 4-4 (4 wheels, 4 cylinders) being the longest running vehicle in production worldwide today.

The aesthetic similarities of the Classic range cars to their 40’s ancestors are still apparent. The cars still evoke the nostalgia and joys of driving from the golden days of motoring but with none of the fragility or temperament. The ‘Classic’ Morgan is now a very different machine underneath with subtle styling and improvements and the latest drive-train technology from Ford.

When Peter Morgan inherited the company from his father, he introduced the first V8 Morgan: the Plus 8. This high performance car put Morgan and the reputation of British sports cars as a whole at the forefront of British engineering and design. This iconic car was later re-launched by the company in 2011.

Peter Morgan’s son, Charles Morgan, is the company’s current managing director. He continues to lead the way in innovative concepts by introducing the first Morgan supercar ‘The Aero’. The all-aluminum bodied lightweight V8 sports car enjoyed many race victories and is the vehicle of choice for enthusiasts who require a car with both the traditional craftsmanship and impressive performance figures to rival its competitors. The Aero has evolved into the high-end luxury Aero SuperSports Morgan sells today.

For full report of the company’s history visit: www.morgan-motor.co.uk/mmc/history.
The cars and how they are made.

- The Cars

Morgan now manufactures over 1300 cars a year and exports over 70% of their annual products. With a turnover of £40 million the company has a niche in the UK manufacturing sector.

The Company now manufacture vehicles based on three platforms;

-The Morgan 3 Wheeler

The launch of the vehicle in 2011 led to worldwide media attention with its entry level pricing and added lunacy. A sub 500kg weight and 1971cc American V-twin, meets bullet style body, fly screens and aircraft switch gear. Steel space frame chassis with Aluminium bodywork and unique styling has contributed to over 1300 sales of this car over the last 18months..

-The Morgan Classic

Considered as the ‘backbone’ of the brand due to its iconic styling and a nostalgic driving experience. 1600cc – 4800cc engine variants.

-The Morgan Aero

The luxury high end sector of Morgan vehicles. BMW 4800cc V8 engine technology, all aluminium construction and a sub 1200kg weight makes this car a serious contender on the racetrack and on long distance touring applications: the finest materials combined with extravagant styling.

(The Morgan 3 Wheeler, Classic range cars, Aero SuperSports)

- The manufacturing process and materials

Each Morgan is built entirely by hand. All materials used during the manufacturing process are natural and processed true to their properties. Each car is unique in that is built to the customer’s specific requirements. Charmingly, each car literally rolls down the base of Malvern Hills during its production.

Efficiency is designed into to the factory layout to enable this. The top of the factory is where the directors and owners manage the company and receives the components that are made off site.
The next factory building down assembles the chassis. Each chassis is assembled by hand, whether it is the aluminum bonded and riveted Aero platform, the Classic galvanized steel ladder chassis or the tubular space frame of the 3 Wheeler.

Next, the Wood framework is built. This is both the ‘coat hanger’ in which holds the bodies but also has natural crash deformability and vibration reduction properties.

(The Morgan wood shop)

The aluminum body consists of a blend of panel beaten sheets and Superformed blown aluminum panels. Superforming is an aerospace process which Morgan were the first to pioneer in automotive manufacturing.

By heating the panels and blowing them over intricate tools the manufacturer can create incredible panel complexity that would usually require multiple panels and extended assembly time. The nature of process means panels are of an optimum weight / thickness and can produce some of the most complex shapes that we model on screen.

Once both the bodies have met the chassis have been assembled, they are hand painted and hand trimmed with real leather. Morgan currently offers over 40,000 colour options and in excess of 500 different leathers.

- **Environmental Consideration**

Typically a Morgan car is owned for a great deal of time. Of the 50,000 cars made at the factory, it is estimated that 90% of these are still in existence; an unusual quality for an automotive manufacture to exude. Morgan is an incredibly environmentally efficient company. The nature of hand assembly means that the consumption of energy within construction is very low. All materials are made in house if they are not locally sourced, thus reducing the size and spread of the carbon footprint. The cars themselves are exceptionally lightweight also result in low C02 output whilst driving.
The challenges and benefits of small business workflow.

- Small business and innovation

Small business and innovation are not necessarily immediately associated with each other. Morgan advocates that when a small team is given the tools to work efficiently, innovative ideas are more frequent.

In order to compete and be noticed, companies need to be increasingly innovative. In doing so you attract new markets and reinforce integrity. For Morgan this innovation occurs largely in the early days of conception and design.

Morgan is a niche vehicle manufacturer operating in a global market place. Its competitors often have enormous budgets or are propped by substantial investors and are growing rapidly.

1.2 million Cars are exported from the UK annually. Of those most are luxury brands such as Bentley, Aston Martin, Lotus, Rolls Royce, Jaguar, and Land Rover. These companies all have significant backing whilst Morgan remains family owned.

- The Development Team

There are eleven people working within Morgan’s development department. The team is responsible for aesthetic and mechanical design, CAD, homologation, electronics, managing ongoing production issues, branding and marketing the vehicles.

Whilst the department is small the benefits are clear: Morgan are in charge of all decisions from concept to production and launch. The small and dynamic team all has the opportunity to showcase their ideas, with the ability to truly influence the end product. Close interactions between different professions creates a broader understanding of the whole work flow.

Most importantly, this close contact means, with the right tools, the team can be fast - Taking new ideas from conception to birth in a fraction of the time. Prototypes aren’t sent off to be tooled or evaluated by a separate group. The team members simply walk on the shop floor to get the onsite craftsmen and women to replicate their design accurately using precise drawings, traditional manufacture methodology and natural ability.
**Collaboration**

These sentiments were noted when Morgan signed a contract for engines from BMW a few years ago. Morgan was able to install a new engine and get it into test in less than a month. A process which BMW say would have taken them years. They said that relationships with businesses like Morgan were becoming increasingly meaningful to them and requested that their senior engineers spend time at the factory to understand the culture that enables projects to be designed, manufactured and developed with a fraction of the time, resource and money it would take them.

(The aluminium Aero - Rolling chassis being calibrated.)

Despite the growing competition in the market place, Morgan has managed to manufacture 1300 vehicles this year. Ten years ago we only manufactured 500 annually.

It is evident that this increase directly coincides with the introduction of modern digital design efficiency and development methods and an increased amount of consideration being paid to the aesthetic design of the products.
The Impact of digital design technologies.

- Pre Digital Design

Early concept cars such as the Morgan Aeromax would be panel beaten into shape from sketches. This highly talented craft involves hand manipulating sheet aluminum over flexible jigs by eye using hammers and English wheels. Whilst this is a whole-heartedly traditional and highly luxurious way of building vehicle bodies, the process was slow and there was little scope for reworking the form with speed.

None the less the car was eventually completed and then displayed. The Aeromax concept car led to the sale of all 100 of the limited edition £110,000 cars in a matter of weeks. The deposits put down funded the tooling of the production panels, the car was scanned in and reworked on screen.

Lack of speed and ability to redesign during creation of a vehicle like this heightened the need to link the initial sketch work to the final production car more efficiently with greater first attempt accuracy.

(Entirely handmade – The Morgan Aeromax)
The Morgan 3 Wheeler (from concept to launch in 18 months).

- **The Intention**

  Morgan decided to re-launch the 3 Wheeler for a number of nostalgic, cultural and economic reasons;

  *Homologation* - makes it increasingly difficult to go global. Important for winter sales at Morgan and to increase the international perception of the brand and British manufacture in general. The 3 Wheeler is homologated as a motor tricycle and as such is exempt from the particularly expensive tests that four wheeled vehicles are subject to.

  *Demographics* – the 3 Wheeler is more affordable, appealing to younger buyer and motor cycle markets whilst still maintaining all the appeals of Morgan manufacture.

  *Brand perception* – Entirely unexpected due fun and exciting motoring that's unique and consequentially turns head.

  *Cultural trends* – ‘British vintage’ / ‘modern vintage’ is becoming increasingly fashionable. This trend is apparent with other recently released vehicles such as Norton and Triumph motorcycles, the new Mini, and the Fiat 500.

  *Motoring* – Traffic congestion, speed restrictions and costs are all combatted with the 3 Wheeler. It is cheap to run and thrilling at any speed.

(Morgan 3 Wheeler - Influence Boards)
The Design Process (Sketch work to Production)

Influence - The 3 Wheeler takes its styling influence from classic aviation and motorcycles. British fashion, classic watches, hot-rods and salt flat racers.

Sketch work – Thumb-nailing and filling pages with ideas is crucial to begin. There’s a set of rules that determine the proportion of particular types of cars. Applying these to blue sky thinking gives you a chance to quickly identify what works proportionally and introduce new themes and ideas. Then tighten the sketch work up; add more detail and consider the package and manufacturing constraints of the design.

Package and reference files - Working closely with the Engineers, the next step was to import hard points into a new Alias scene. Lighten this data as much as possible especially if it is sourced from 'solid' modeling platforms. Only the most basic key surfaces and extremities are needed to construct your volume model. At this point this data is combined with imported canvas plane drawings. These drawings were cropped accurately in Photoshop and colored with a 40% grey. Once dragged directly onto the relevant view ports and scaled, the opacity was lowered so as not to confuse the surfacing.

Surfacing - Here the designer spends time forward planning the construction of the model. Time wasted reworking surfaces that are poorly assembled may occur later on when fast problem solving is required.

Plan to create the simplest surfaces as possible. Try to never inflect individual curves. Each directional change should have its own curve and alignment should be used from the offset when creating the curve network. A good solid curve network with well evaluated lines also produces greater surface continuity.
It is not always the lines in a sketch or the crease on a body panel that describe a car but what the light is doing on the surface. The way light moves across a car, by the sharpness and direction that the reflections are sent, provides the visual drama or weight reduction of a surface.

It is this design that is difficult to get across in a sketch, and time consuming in manual renderings, which is why Morgan's designers are always quick to get into this basic surfacing stage. Alias has a lot of functionality here and images like the one attached demonstrate its internal rendering capabilities. Try to get into showcase for increased visual evaluation.

**Evaluation** – For the 3 Wheeler, due to the simplicity and honesty of the form, a full size Styrofoam model was all that was needed to review the form in large scale. This was machined directly from the Alias data. The introduction of a high fidelity power wall would also satisfy this evaluation stage. The physical model also allows engineers to start assessing tooling and detail assembly.

![Morgan 3 Wheeler – Surface evaluation](image)

Calculated continuity meant that the curve of the vehicle in plan view carried a little too much fluidity and needed squashing and pinching a little. The highly trained surface finishers in the paint shop helped rework the surface in real life. The surface was then re-painted and rescanned back into Alias.

This fast relationship between on screen surfacing, using this data to cut physical models, rescanning and reworking surfaces has dramatically sped up the evolution of the design.

Aside from aesthetic evaluation, tooling feasibility is carried out on the individual panels of the vehicle to ensure that each can be made to the high tolerance and performance attributes required of it.

Alongside this designers are using tools such as ‘Project Falcon’ to assess the aerodynamics of the design and prevent against costly rework at a later stage.

**Zero Cost Sign off** - All the work carried out so far, with the exception of a low cost foam model, has cost no more than the labour time of four employees. The Alias model now completed and detailed can be
introduced in to Showcase where a presentation file can be created. Presenting this to directors enables a very low cost sign off.

**Concept launch:** The first car is then prototyped using the data from Alias. Wooden bucks created in the wood shop are accurately produced from cross sections of the Alias data. The panel beaters work the aluminium sheet accurately over these creating a form true to the initial design. In the case of the 3 Wheeler, some surfaces were A-class at this stage. The Alias data was used to directly tool some of the prototype panels. The car was assembled and launched at the Geneva motor show 2011. 200+ sales were made that week.

**Autodesk applications beyond vehicle design.**

- **Promotional material.**

  As print deadlines far exceeded the completion of the first prototype vehicle, the renderings created in Showcase were used for the promotional launch material that was circulated worldwide.

(Morgan 3 Wheeler – Promotional material)

- **Production Design.**

  Typically in the past, additions or size increases within the Classic range would be done by eye on the shop floor. With the integration of Autodesk design and visualisation tools, Morgan is now able to rework and visualise new vehicles and components at low cost with speed. The re-launch of the Morgan Plus utilised the same work flow as above.
Bespoke One – Offs and Concept Cars.

Increased speed of design and the ability of directors or customers to sign off proposals on screen before production commences now exists. When combined with a workforce that are able to manufacture vehicles by hand from raw material, one-off bespoke vehicles can be entertained without large budgets or demand on resource.

Customer Specification.

Every Morgan is built to order. The customer witnesses the entire build of their car and is able to specify every detail of its aesthetic from the outset. Showcase enables designers and sales teams to create scenes that can quickly alter the appearance of a proposed vehicle. Designers then set up a Showcase scene with many alternatives that include paint, leather, wood, dash, and wheel options. The customer is now given a photo realistic impression of what their car will look like before a penny is spent.

Show Stand Design

Each year Morgan exhibits their products at a number of shows around the world. The show stands for these are designed and simulated on screen. Following sign-off, the wood shop is able to recreate the structure accurately at exceptionally low cost.

The Future.

Project Forge – Faster Efficient Modeling.

Morgan will now be implementing T-Spline technologies into their work flow. The ability and ease of modeling surfaces that can directly relate to Alias and showcase is invaluable when resources are already stretched.
Advanced Visualisation

Morgan is exploring more powerful rendering packages and updates from Autodesk. When carrying out many ‘on screen sign offs’, the speed and accuracy of the visual is increasingly important.

Display, Process, Manage

Autodesk provides exceptional cloud based processing options and are now launching an impressive PLM catering for the needs of any designer undertaking detailed project work.

Morgan – What’s Next?

The Morgan Motor Company is now manufacturing more vehicles than ever before. The media and consumer attention is greater than ever and the company are in a strong position to improve brand perception and innovate with more speed than ever before.

From a visual point of view vehicles are expected to evolve drastically over coming years. The tension of the curves will be increased, body surfaces will exude higher aerodynamic ability, and the Morgan Supercar will continue to attract a buyer seeking a level of bespoke manufacture and tradition not apparent with its competitors.

Modern trends in automotive sales suggest a clearer division between economical, luxury and unique vehicle manufacture. The latter is a market sector that Morgan excels within. No other manufacturer in the world makes vehicles with such individuality. Given the technology to create vehicles like this to satisfy demand, the future is one that is filled with exciting opportunities for Morgan Motor Company.

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