Global Forces in Vertical Flight Technology

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AHS International
The Vertical Flight Technical Society

www.vtol.org
Overview

- Economic Outlook for Rotorcraft
- Global Competition
- Technologies for Vertical Flight
- Vision and Leadership
What is AHS International?

- Founded in 1943 as the American Helicopter Society
  - Now the global vertical flight technical society
- Expands knowledge about vertical flight technology and promotes its application around the world
- Advances rotorcraft safety and acceptability
- Advocates for vertical flight R&D funding
- Helps train the next generation of vertical flight leaders
Many exciting VTOL concepts now being explored
2014 Student Design Competition: X-VTOL based on DARPA VTOL X-Plane

Georgia Tech (1st Grad)

Politecnico di Milano (2nd Grad)

St. Louis Univ. (1st Undergrad)

Georgia Tech (2nd Undergrad)

Rensselaer Polytechnic Institute (3rd Grad)
Industry Outlook: Overview

Civil & Military Production Units, 2010-2020

Robinson Helicopters at the factory

Civil & Military Production Value, 2010-2020

USMC MV-22 Osprey deployed on USS Wasp

Forecast as of 8 Oct 15
Industry Outlook: Breakdown

Civil Production Units, 2010-2020

Military Production Units, 2010-2020

Civil Production Value, 2010-2020

Military Production Value, 2010-2020

Forecast as of 8 Oct 15
US Losing Market Share

2010-2014

- Sikorsky, 20.288%
- KAI, 0.783%
- HAL, 0.853%
- Robinson Helicopter, 0.863%
- Eurocopter, 0.907%
- Avicopter, 1.214%
- AVIC, 1.54%
- All Others, 2.539%
- NH Industries, 5.999%
- Bell Helicopter, 5.788%
- Boeing, 9.504%
- Airbus Helicopters, 12.584%
- AgustaWestland, 10.444%
- Bell/Boeing, 10.085%

Forecast as of 8 Oct 15

Sikorsky S-76D

Kamov Ka-62

2015-2020

- Russian Helicopters, 19.487%
- Airbus Helicopters, 16.033%
- Sikorsky, 15.538%
- AgustaWestland, 10.497%
- NH Industries, 5.877%
- Boeing, 7.066%
- Bell Helicopter, 8.643%
- Bell/Boeing, 5.774%
- Avicopter, 1.332%
- KAI, 1.783%
- AVIC, 1.997%
- All Others, 1.907%
- TAI, 1.99%
- Robinson Helicopter, 0.907%
- HAL, 1.243%

Forecast as of 8 Oct 15

$140B

$120B
All-New W. European Products

Airbus Helicopters H175 (2009)

AgustaWestland
AW189 (2011)
AW139 (2001)
AW169 (2012)

Airbus Helicopters H160 (2015)

Marenco Swiss helicopter (2014)

Reference: Vertiflite, Mar-Apr 2012
Bell 525 Relentless

- 18,000 lb civil transport
- Announced February 2012
- Service entry early 2017
- ~70 orders
- First Flight July 1
- 3 in flight test by end of 2015
Bell 505 Jet Ranger X

- Announced June 2013
- Named February 2014
- First Flight November 2014
- 3 prototypes flying
- 350+ orders

- 5 seats
- Bell 206L-4 dynamics
- Turbomeca Arrius 2R (504 shp)
- Garmin G1000H glass avionics
- New “green field” factory in Louisiana
Joint Multi-Role (JMR) Preliminary Design Phase

Sikorsky/Boeing SB>1 Defiant

Bell V-280 Valor

Karem TR-36

AVX

Reference: Vertiflite, Jan-Feb 2014
Bell JMR Demonstrator

- V-280 Valor tiltrotor
- Fuselage assembly began in June
- Composite cabin, cockpit, fuselage built by Spirit AeroSystems
- Delivered September 22
- First flight expected in 2017
Sikorsky High Speed Rotorcraft

- **X2 Technology™ Demonstrator**: 2.5 t (5,500 lb)
- **S-97 RAIDER™**: 5 t (11,000 lb)
- **JMR TD**: ~13.6 t (30,000 lb)
- **FVL**: 13.6 t (30,000 lb)

Timeline:
- 2010
- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2025
Sikorsky S-97 Raider
X6: Super Puma Replacement
Next Airbus Helicopters Product

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Airbus Helo Demonstrators

X3 High Speed Helicopter
260 kt

Blue Edge
Passive Noise Cancellation

Blue Pulse
Active Noise Cancellation

Bluecopter
Eco Demonstrator
AW High-Speed Rotorcraft

BA609 Civil Tiltrotor

Project Zero Concept Vision

Project Zero Full-Scale Demonstrator
Clean Sky 2

Flying Demonstrators in 2020
- Airbus Low Impact Fast & Efficient RotorCraft (LifeRCraft)
- AgustaWestland Next Gen Civil Tiltrotor (NGCTR)
Safety and Noise
Technologies for the Future (1)

- New design tools (e.g. CFD/CSD)
- Advanced configurations
- Variable rotor speed
- Low noise blades
- High performance rotors
- Active/adaptive rotors
- Swashplateless hub
- FBW/FBL flight controls
Technologies for the Future (2)

- New manufacturing methods
  - Lean, Automation, RF ID Tracking
- Advanced composites
  - Unitized Composite Structures
  - Automated Fiber Placement
- Advanced engines
  - high P/W, low sfc, low emissions
- Advanced transmissions
  - high efficiency/low weight
- Biofuels/reduced carbon footprint

Many fertile areas being explored for potential
“Vision without action is a daydream. Action without vision is a nightmare.”
– Japanese Proverb

“Vision without funding is a hallucination”
– Major Mike Witteried, USAFR, Joint Staff (1995)

“Leadership is just as important as funding, and funding is just as important as leadership.”
– Mike Hirschberg
Recommendations for NASA

- Continue to support Blue Chip personnel and facilitates
- 2x increase in RVLT funding – back to historical levels
  - A well-thought out plan that is well-supported by industry and academia, and synergy with other government agencies where sensible
- Continue to increase the funding for Transformative concepts and look for synergies and cross-fertilization of tools, technologies and resources
- Work with the VTOL community to enable to future of vertical flight
Questions?

www.vtol.org
New Light Civil Rotorcraft

Enstrom TH180*
First Flight 2015

Guimbal Cabri G2*
Certificated Dec 2007

Konner K1
First Flight April 2012

Marencos Swisshelicopter: First Flight Oct 2014

References: Vertiflite, May-Jun 2013 and Jul-Aug 2014

* Piston powered
Chinese Rotorcraft

- China operates few civil helicopters, some police/paramilitary
- Recent purchase of Enstrom
- Military purchased or produced Russian or European models
- Cooperative developments with Eurocopter for civil and military
- Indigenous developments

Reference: Vertiflite, Jan-Feb 2013
Russian Helicopters

- World’s largest helicopter producer (by value)
- Combines Kamov, Mil, Kazan, etc.
- Modernizing aircraft for civil and military customers

- Mi-38
- Mi-17V5
- Mi-26 and Ka-52
- Mi-28N
Hindustan Aeronautics Limited (HAL) licensed production of Eurocopter designs began in 1960s
  - Developed indigenous variants (e.g. high altitude)

HAL developed Dhruv Advanced Light Helicopter (ALH) – also civil and export

HAL developed derivative Light Combat Helicopter (LCH)

Tata Joint Ventures with AgustaWestland and Sikorsky for production

Reference: Vertiflite, Spring 2011
Primarily US produced or licensed helicopters for military
- Fuji-Bell UH-1 Huey
- Kawasaki-MD OH-6 Cayuse

Kawasaki Heavy Industries (KHI) joint development with MBB/Eurocopter of BK117

Kawasaki OH-1 Ninja Light Observation Helicopter (LOH)

Kawasaki UH-X utility helicopter for Japan Ground Self Defence Forces
- Development started March 2013
- First flight 2018

Reference: Vertiflite, Jul-Aug 2012
Korean Rotorcraft

- Primarily US and European produced helicopters
- Indigenous development of Korea Aerospace Industries (KAI) Surion Korean Utility Helicopter (KUH)
  - Assisted by Eurocopter
- Full-scale production of 24 for the Army began in 2012
  - 40 Surions for Korean Marine Corps planned by 2023
- New co-development
  - Light Civil Helicopter (LCH): 2020
  - Light Armed Helicopter (LAH)

Reference: Vertiflite, Jul-Aug 2013
Turkish Rotorcraft

- Turkish Aerospace Industries (TAI)
- Licensed production of S-70 Black Hawk and key supplier
- TAI-AW developed T129 ATAK
- 5-6t Indigenous civil / Utility Helicopter

Reference: Vertiflite, May-Jun 2014