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International Cooperation in Metal Forming Research

-Selected Case Studies-

prepared for

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by

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International Cooperation in Metal Forming Research

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- Introduction / General Observations
- ERC/NSM at Ohio State University
- Cooperation with European Institutes /Universities
- IFU and ERC/NSM Special Relationship
- Case Studies
- Summary and Future Outlook

- In manufacturing and metal forming technologies competition from industrialized nations will continue to increase (too much capacity, need for survival, intense competition from low wage countries).
- Low wage countries (Eastern Europe/ South East Asia) represent formidable competition (access to capital and technology, government subsidies, improving infrastructure, well trained and inexpensive manpower) examples: METU, Shanghai Die and Mold Center.
- Graduates in most low wage countries are from a highly selected group, have excellent capabilities and motivation. Thus, global competition for jobs has become more severe.

- Germany and Japan have a large number of universities that offer courses in metal forming. Very few U.S. universities teach metal forming adequately.
- In the U.S. and Japan, most professors who teach metal forming and / or manufacturing do not have any industry experience.
- In both Germany and Japan, there is an excellent infrastructure for cooperation between universities, industry and engineering societies to encourage the advancement of metal forming technology (JSTP, ICFG, university conferences).

- The U.S. has some advantages compared to other industrial nations because
 - a) English is accepted as the global language of business, science and technology
 - b) The U.S. has largest market for manufactured goods, notably for cars, trucks, and aircraft.
 - c) The U.S. offers flexibility in business culture and a social infrastructure that encourages immigration of well trained and educated international manpower



ERC for Net Shape Manufacturing

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The ERC/NSM emphasizes process simulation and in-plant testing in:

- precision cold, warm and hot forging
- stamping and sheet metal forming
- sheet and tube hydroforming
- mechanics of machining (high speed, hard machining)
- education and training for industry in metal forming



ERC for Net Shape Manufacturing

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The ERC/NSM has:

- adopted many of the positive aspects of the Germany engineering education system without losing the strength of the engineering science education offered by the U.S. system
- established close relations with many large and small manufacturing companies so that ERC research is strongly coupled with industry projects
- excellent relations with many European (mainly German) universities. Over a period of 15 years more than 200 European students completed an MS thesis or equivalent at the ERC/NSM



Cooperation with European Institutes / Universities

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- Visiting Scholars to complete their MS thesis (Diplomarbeit) or equivalent (6 to 7 months stay)
- Visiting Scholars to carry out Doctoral Research (6 to 8 until now)
- A few U.S. students who spend time in German Institutes (IFU, WZL, IBF)
- Visiting Scholars from Universities of Stuttgart, Darmstadt, Aachen, Hannover, Dortmund, Karlsruhe, Munich, Brescia and several Universities of Applied Science



Cooperation with European Institutes / Universities

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- Student contacts ERC/NSM indicating interest
- Approval from his/her advisor (or Betreuer) requested
- Topic outlined in general terms / paperwork for visa started
- Student arrives, prepares a project plan, his / her Betreuer is informed
- Project conducted, a report (Diplomarbeit) is written in English and recognized by his / her institution



IFU and ERC/NSM Special Relationship

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- Started with Prof. K. Lange, continued under the leadership of Prof. K. Siegert (IFU)
- IFU provided considerable assistance to ERC/NSM
- The first reunion of the ERC Visiting Scholars was held at IFU laboratory in Sept. 2000.
- Second and third reunions were held / will be held in Columbus, Ohio in Sept. 2002, and Brescia, Italy in Sept. 2004, respectively.



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- Markus Knoerr, Dr. Ing. 1995, Mataldyne, USA, “Die Design for Hot and Cold Forging Using FEM”
- Martin Matheis, Dipl. Ing. 1996, Hilti, “Evaluation of Friction and Formability in Forming Al Sheet”
- Stefan Beck, Dipl. Ing. 1997, BMW, “Tool Wear in Blanking”
- Martin Gruenbaum, Dipl. Ing. 1997, DaimlerChrysler, “Investigation of Part Quality in Blanking”
- Matthias Aust, Dipl. Ing. 1998 (Dr. Ing.), Thyssen Krupp Drauz, “Friction in Tube Hydroforming”



IFU and ERC/NSM Special Relationship

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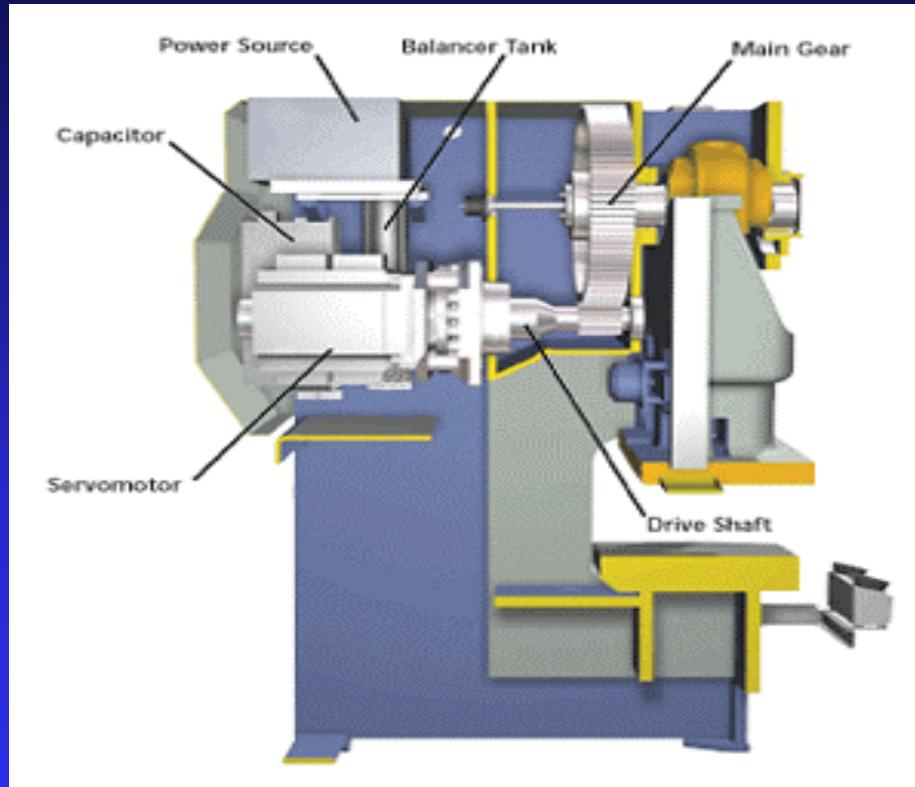
- Jochen Breitling, Dr. Ing. 1998, BMW, “Investigation of High Speed Blanking”
- Gerhard Gutscher, Dipl. Ing. 2000, Thyssen Krupp Drauz, “Determination of Flow Stress Using the Viscous Pressure Bulge Test”
- Stefan Jaeger, Dipl. Ing. 2000, IFU, “Lubrication in Tube Hydroforming”
- Siegfried Loesch, Dipl. Ing. 2000, Thyssen Krupp Stahl, “Investigation of Lubricants for Cold Forging”
- Achim Wilging, Dipl. Ing. 2002, Uni-Munich, “Viscous Pressure Forming of HSS, Al and Mg Alloys”

Warm Deep Drawing of Mg and Al Alloy Sheet

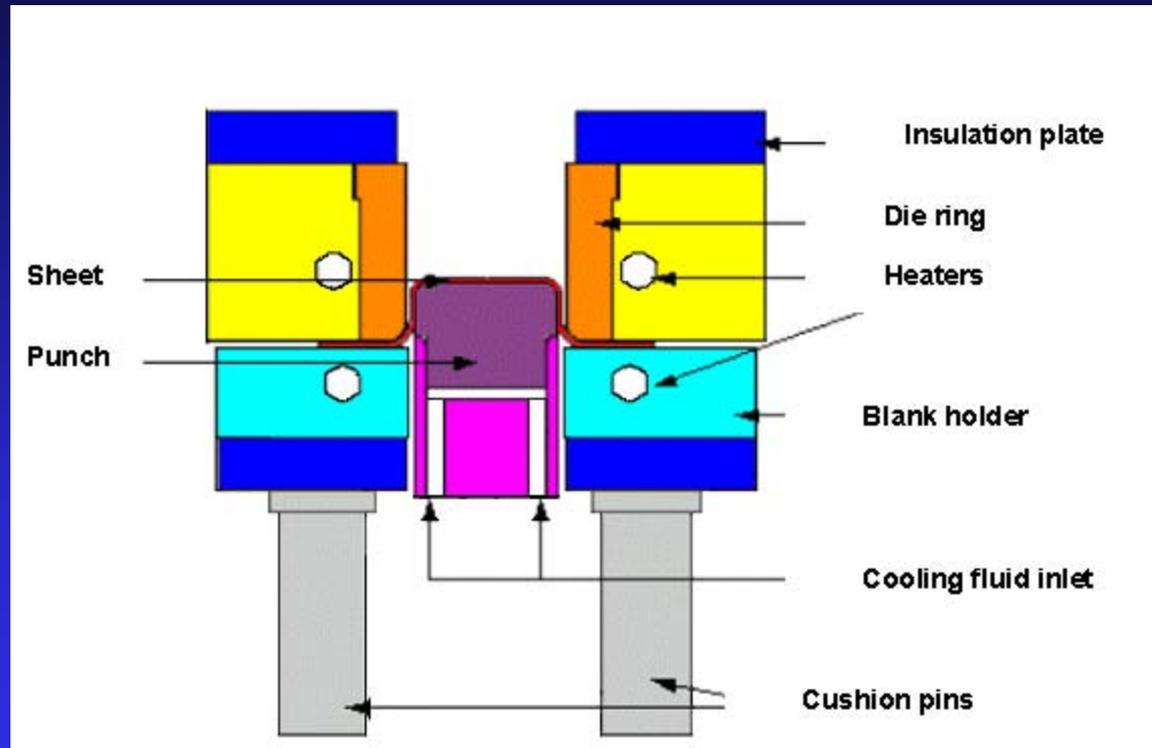
Ms. Andrea Aginagalde, Mondragon University, Spain, 2004

The objective of this study is to determine the optimum process variables to obtain the highest possible Limiting Draw Ratio by modifying

- initial temperatures of the punch, die and blank holder
- initial blank temperature and ram dwell time
- blank holder force



Press Mechanism of the NC1 AIDA Servo Press



Schematic of the Warm Forming Tool that Would be Used in the AIDA NC1 Servo Press



Summary and Outlook

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- Global competition for markets as well as for jobs will continue to increase.
- New graduates with knowledge of foreign languages, mainly English, and cultures will have a competitive edge.
- International cooperation in research and student exchange offers benefits to new graduates, as well as home and host institutions.