

technology, and in an increasingly competitive global marketplace, the Canadian industry must remain competitive by investing more of its resources into R & D. The Canadian aerospace industry invests approximately 10 per cent of its revenue in R & D. This is respectively 7.5 per cent and 6 per cent less than its American and European counterparts.<sup>17</sup> At the same time, Canada will also have to increase subcontracting and co-operative agreements with large international manufacturers to reduce the technological and commercial risks inherent in the development of new technologies.

### Canadian Space Industry

The Canadian space industry is a distinct component of the aerospace industry, although it is relatively small in comparison to its counterparts in other developed nations. This industry is highly dependent on Canadian government procurement<sup>18</sup> for its domestic market, and the Canadian market is of limited size; therefore, companies within the industry, as in the rest of the aerospace industry, have had to look to exports in order to survive (in 1986, 70 per cent of sales were exports). This is necessary in order to reach a level of sales that would support continued growth and a level of R & D necessary to maintain a competitive edge. Moreover, they are forced to compete on the basis of better technology, since the absence of volume production makes for lower price competitiveness compared with companies from the U.S., Europe and Japan.

There are approximately 50 Canadian companies, most of them Canadian owned, involved in the space industry. The only Canadian prime contractor manufacturing complete space systems is Spar Aerospace. Spar, a world-class satellite manufacturer, secures almost half (approximately \$400 million) of all sales of the Canadian space industry. Spar, along with the other major players -- MacDonald Dettwiler (SAR imagery), Com Dev (subsystems for satellites), Canadian Astronautics (advanced scientific experiments in space), SED Systems and Intera Technologies -- makes most of the industry sales.

The companies of the Canadian industry specialize in communications, remote sensing satellite systems<sup>19</sup> and, to a lesser degree, robotics for use in space. Basically defined, the following

classifications identify the product categories in which Canadian companies are active:

- . communication satellite systems and subsystems (space-segment payloads such as antennas, transponders, signal processors, and transmitting and receiving stations and antennas);
- . remote sensing satellite systems and subsystems (space-borne sensors and material for the reception, processing and analysis of remotely sensed data);
- . robotics and space tele-operators (tele-operators [man-in-the-loop, Canadarm-type manipulators], next generation of automatic dexterous manipulators for the international space station program);<sup>20</sup> and
- . launch systems (small sounding rockets for scientific experiments).<sup>21</sup>

Canada is one of the principal markets for and end-users of space products and services, along with other developed countries. (It follows the U.S.S.R., the U.S., Japan, France and the Federal Republic of Germany; it ranks equally with the U.K. and Belgium.) Canada was the third nation to put a satellite into space (Allouette 1 in 1962) and the first to establish its own domestic telecommunications system using a geostationary orbiting satellite (Anik A1 in 1972).<sup>22</sup> Nevertheless, the domestic market remains insufficient to sustain a national industry.

Space product procurement for non-military use in industrialized countries has been increasing (see Table 4 in Appendix A). However, expenditures for military space procurement are considered to be much greater than civilian expenditures, especially in the U.S.

The Canadian space industry retains an important share of the world market for some specific subsystems. For example, Com Dev manufactures about 70 per cent of the radio frequency multiplexing subsystems (signal-processing devices) used in communication satellites in the free world; MacDonald Dettwiler (MDA) is a worldwide leader in the field of reception, processing and analysis of remotely sensed data; Spar Aerospace manufactured