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Private participation in defence production to wait

Ministry task force had given a set of criteria for selecting strategic partners

When the much awaited Defence Procurement Procedure (DPP) is unveiled later this month, a critical reform, meant to induct the private sector in a major way into defence manufacturing, will be missing.

Senior officials said there was still no clarity on how to select private companies to become strategic partners in defence procurement programmes despite recommendations of committees on ways to reduce India's embarrassing dependence on imports. The DPP will be made public on March 28, coinciding with the DefExpo in Goa, and will come into effect from April 2.

Defence Minister Manohar Parrikar was quoted as saying that the chapter on identifying strategic private sector partners was going "through an extensive exercise that will take another month or two" and it requires approval from the Cabinet Committee on Security. The chapter which would have listed major Indian private sector companies identified for preferential treatment, would now be on hold.

Senior officials, however, are not surprised. Nor is it the first time that a major recommendation to give private sector companies preferential treatment has run into obstacles.

In 2006, the UPA government had recommended Raksha Udyog Ratnas status to a dozen major private industry players giving them preference at par with defence PSUs in contracts. The government had to shelve the plan in the final moment because of opposition, from both the trade unions of DPSUs and from Indian private players who were left out of the list.

The present effort to grant the status of "strategic partners" flows from the recommendations of the Dhirendra Singh Committee, formed by the Modi government in May 2015, to evolve a robust policy to facilitate 'Make in India' in the defence sector. The report recommended identification of private sector companies that could play a key role in developing and manufacturing of complex and strategic systems or receive significant technology transfers from abroad for manufacture in India. The Ministry's task force to work out the modalities for implementing the recommendation, suggested creation of two groups — group 1 for aircraft, aero-engines, helicopters, submarines, naval ships, guns and armoured vehicles and group 2 various materials and alloys, composites and polymers, and ammunition. It gave a set of criteria for selecting strategic partners.

"How do we draw up a set of criteria without subverting merit?" a senior official wondered. The official said it was a highly contentious exercise and one where the government may not find an easy solution. There have been several rounds of discussions but a consensus is nowhere in sight, he admitted.

Delay in defence procurement procedure

New Delhi : The new Defence Procurement Procedure (DPP) does not include crucial chapters on the involvement of private sector in manufacturing military hardware and the role of middlemen.

Approved by the Defence Acquisition Council, headed by Defence Minister Manohar Parrikar, it does not have those critical information as the government seeks more time to prepare the final document, for which the industry is waiting.

The chapter on strategic partnership would take more months to complete. An approval from the Cabinet Committee on Security would subsequently be required to try out the new experiment in which the private companies are likely to be handpicked to manufacture military platform under government's supervision, sources told Deccan Herald.

The minister said focus would be on ammunition, followed by P75I submarine project (a second assembly line for conventional submarines) and possibly a chopper and a fighter contract. "The aim is to start one-two projects under the strategic partnership model by 2016 end," he said.

Several big firms like Reliance, Tata and Mahindra are waiting for the document to be finalised before pitching in with proposals. While Mahindra joined hands with BAE System, the Tata Group tied up with Boeing and exploring other avenues.

About a fortnight ago, Reliance obtained 12 industrial licenses from the Department of Industrial Policy and Promotion under the Commerce Ministry to manufacture military aircraft, helicopters, long-range missiles, combat vehicles, air independent propulsion technology and hull penetrators for the navy and unmanned aerial vehicle. The new DPP, Parrikar claimed, would allow the DAC to take a 'fast-track' route to acquire weapons, something which was limited to only the armed forces till now.

The Pioneer
23 Mar, 2016

The Pragmatic Approach

New Defence Procurement Policy makes sense

With a focus on indigenisation, transparency and procedural efficiency, the new Defence Procurement Policy seems to have shaped well. Some important parts have already been cleared by the Government, such as the new Indigenously Designed, Developed and Manufactured equipment category which will boost the domestic defence industry, as well as the new offset clause which requires only those foreign manufacturers with contracts over Rs2,000 crore, as opposed to the previous Rs300 crore limit, to source 30 per cent of their components from India. On Monday, Defence Minister Manohar Parrikar announced that the entire policy will be unveiled at the defence exposition in Goa later this month. There is still one chapter, dealing with 'strategic partners', that is yet to be finalised. These 'strategic partners' are private sector entities that the Government will identify for large, capital-intensive projects such as the production of helicopters, tanks and submarines. Once finalised, this will be an important first in the Government's significantly revamped approach to defence acquisition and manufacturing. Other important changes include an overhaul of the penalisation process to end the blanket blacklisting of firms that have been accused of wrongdoing. Currently, firms are banned the moment there is a charge against them. This is akin to being held guilty until proven innocent — and the latter often takes several years. Meanwhile, defence acquisitions are stalled and war preparedness hampered. Under the new policy, firms will have the opportunity to present their case before facing punitive measures. There will also be graded

punishments in keeping with the quantum of wrongdoing. In case of serious charges, temporary measures (with deadlines) will kick in until a committee finally decides on the merits of the case.

A related change is the legitimisation of company agents these authorised representatives play an important role, providing technical expertise or management support, but are often portrayed as unscrupulous middlemen. By recognising them as part of the business arrangement, the Government is making the process transparent and more accountable. A third change is with regard to the single-vendor situation. While it is preferable to have more competition, there are times when only one firm has the product that meets all the requirements. However, in such situations, bureaucrats are often reluctant to proceed, fearing corruption charges at a later stage. The new DPP takes the poison out of the single-vendor situation. Another important change is the addition of the Enhanced Performance Parameters which shifts the bottomline from the cheapest product to the best value product. Currently, the bidder offering the lowest price wins hence, manufacturers often cut corners and the military gets a bare-bones product. With a little more flexibility now, the Government can get a lot more bang for its buck.

The Pioneer
23 Mar, 2016

Kirti Chakra Conferred on Pathankot Martyr

President Pranab Mukherjee on Tuesday honoured 58 Defence and Paramilitary personnel with Gallantry awards, including sepoy Jagdish Chand with Kirti Chakra for his bravery in chasing and killing one of the terrorists who hit the Pathankot airbase before being martyred.

Chand was honoured with Kirti Chakra, the second highest peace-time decoration, for displaying great presence of mind, valour and conspicuous gallantry before making the supreme sacrifice.

His award was handed over by the President to his wife, who received a rapturous clapping from the audience which included Vice President Hamid Ansari, Prime Minister Narendra Modi and former Prime Minister Manmohan Singh, among others.

Col MN Rai of Gorkha Rifles was honoured with Shaurya Chakra (Posthumous) for unprecedented courage and valour, well beyond the call of duty, that he displayed during an encounter in Pulwama district of Jammu and Kashmir on January 27 last year.

His daughter, Alka Rai, who had left the nation emotionally devastated as she rose above her grief to shriek an old Gorkha war cry just before his cremation last year, stood up in attention as her mother received the award from the President.

Havildar Tanka Kumar Limbu of the 21 Para, who had taken part in the operation on June 8, last year along the Indo-Myanmar border, was also given Shaurya Chakra.

The Hindustan Times
23 Mar, 2016

US firm to develop defence systems for Ashok Leyland

Ashok Leyland Defence Systems (ALDS), a division of Hinduja Group flagship company Ashok Leyland, on Tuesday said it has selected US-based Lockheed Martin to develop light specialist vehicle and light armoured multi-purpose defence vehicles for armed forces.



IAF's Akash Ganga sky diving team performs at MA Stadium during Air Force Adventure Sports Mela in Jammu on Tuesday. PTI

China More Assertive During LAC Patrol: Report

New Delhi: The Defence Ministry has red flagged the “ongoing contestations“ over island territories in the Asia Pacific as a threat to security in the region even as it said there has been an “increase in assertiveness“ during routine patrolling by the Chinese army along the LAC. In its annual report released here, the ministry also said that radicalisation and fresh recruitment in South Kashmir are a “cause of concern“. “External factors, including the changing situation in Pakistan and Afghanistan, may also impact the internal situation in Jammu and Kashmir,” the report said.

No Mention of Pak, China Challenge on Def Report

In a clear departure from the past, the annual report of the Defence Ministry for 2015-2016 released here on Tuesday refrained from naming Pakistan and China. Earlier reports used to clearly state that terror infrastructure in Pakistan and growing military might of China pose security challenge and India's continues to monitor the scenario.

However, this time round the 237-page report preferred to mention that "terrorism emanating from India's neighbourhood and Af-Pak region continuing to be epicentre of international terrorism" is a matter of concern. The only reference to Pakistan without identifying it comes when the document says developments in Jammu & Kashmir and Punjab, especially the cross-border terror attacks and trafficking or arms and narcotics is a cause of concern.

The report goes on to say even as overall security situation in Jammu & Kashmir remains stable, external factors — including the changing situation in Pakistan and Afghanistan — may also impact the internal situation in the border State.

In comparison, last year's annual report(2014-2015) said "Pakistan continues to remain home to several Non-State actors with North Western Frontier Province (NWFP) serving as the fountainhead for terrorist activity in the region. Pakistan's quest for strategic depth in Afghanistan continues to drive its policy to support Taliban and its affiliates in Afghanistan."

"The expanding footprints of extremist and terrorist organisations in Pakistan and their linkages with terrorist activities in J&K and rest of India poses a major security challenge to India, with severe ramifications on bilateral relations, as well as to the peace and security of the region," it said.

"The use of terrorism as an instrument of state policy has deep roots in Pakistani military establishment. Ceasefire violations and infiltration from across the border also continues unabated. India desires peaceful and cooperative ties with Pakistan. However, continued activities of terrorist organisations operating from Pakistani territory and territories under Pakistan's control are major obstacle and source of concern," the last year report said.

While this year's report did not touch upon China let alone naming it, last year's report clearly stated India remains "conscious and watchful of the implication of China's increasing military profile in our immediate and extended neighbourhood, as well as the development of strategic infrastructure by China in the border areas." India is also taking necessary measures to develop the requisite capabilities to counter any adverse impact on our own security, it said.

Coming to the latest report, the document said terrorism and the activities of terrorist organisations are perhaps the most serious threat to peace and security. "The use of terrorism as an instrument of policy by a few states has exacerbated intra and inter-state conflicts."

Terrorist groups have leveraged new technologies, particularly in cyberspace, for trans-national mobilisation and ideological radicalisation, especially of the youth. They also continue to gain logistical and financial support for their activities from disparate sources including some States, and are increasingly able to threaten regions well beyond their base areas, the report said.

Without mentioning China In the context of it flexing muscle in South China Sea, the report said renewed maritime disputes in the Asia-Pacific region has introduced new dimensions in military and diplomatic interactions among the major powers and regional States. Ongoing contestations over island territories in the region have fuelled regional tensions that could seriously strain the co-operative structures that have enabled a rapid growth of the Asia-Pacific region as an engine of global growth.

India has major strategic interests as well as economic and commercial stakes in the region and holds the view that all countries must exercise restraint and resolve bilateral issues diplomatically and without recourse to the use or threat of use of force, the document said.

Deccan Herald
23 Mar, 2016

Pakistan out of SAARC satellite project

Now, project to be named 'South Asia satellite'

New Delhi: Pakistan has opted out of the South Asian Association for Regional Cooperation (Saarc) satellite project.

The move comes even as Prime Minister Narendra Modi's proposal to boost space cooperation among South Asian nations evoked overwhelming support from all other members of the eight-nation bloc.

Islamabad conveyed its reluctance to join the project during meetings of the senior diplomats of the member nations of the bloc at Pokhara in Nepal last week. "Pakistan has decided to opt out of the satellite project," said India's External Affairs spokesperson Vikas Swarup.

Pakistan's decision to dissociate itself from the project would mean that the satellite could no longer be named the Saarc satellite. New Delhi, however, already mooted an alternative name for the satellite and it was accepted by other countries - Bangladesh, Sri Lanka, Maldives, Afghanistan, Bhutan and Nepal.

"So it cannot be called a Saarc satellite. It will be a South Asia satellite," Swarup told journalists in New Delhi.

According to the sources, Islamabad's representatives their counterparts from India and other South Asian nations at Pokhara that Pakistan itself had advanced space technology and had no interest in the satellite, which India had offered to build and launch for the entire region.

Modi mooted the idea during his maiden visit to the Indian Space Research Organisation's launch station at Sriharikota in Andhra Pradesh on June 30 - just a few weeks after he took over as prime minister on May 26, 2014.

Later, while addressing the 18th Saarc summit in November 2014, Modi announced India's offer to build and launch a satellite, which would benefit all member nations. He said that the satellite should be launched by the end of 2016.

The legal framework for the satellite was laid in September 2015 when Sri Lanka signed the first orbit frequency coordination agreement with India.

New Delhi's offer to build and launch the satellite is perceived as a strategic move by India to counter China's plan to boost its space cooperation in with South Asian nations.

The Indian Express
23 Mar, 2016

National Optical Fibre Network project: Fast internet, slow implementation

National Optical Fibre Network project hits speed breakers as limited resource deployment by institutions, issues in co-ordination and mobilisation pushes deadline by nine months.

The Department of Telecommunications (DoT) has come down hard on RailTel for slow progress of work relating to the National Optical Fibre Network (NOFN) project, which it said holds high importance for Prime Minister Narendra Modi.

ACTIVE GRAM PANCHAYATS AS ON MARCH 21, 2016

State	Count	Executing agency
Assam	50	BSNL
Bihar	130	BSNL
Chandigarh	12	BSNL
Chhattisgarh	435	BSNL
Haryana	125	BSNL
Karnataka	2,699	BSNL
Kerala	1,129	BSNL
Madhya Pradesh	56	BSNL
Maharashtra	97	BSNL
Rajasthan	192	BSNL
Uttar Pradesh	185	BSNL
Uttarakhand	87	BSNL
Andhra Pradesh	15	N.A.
Jharkhand	127	PGCIL
Odisha	36	PGCIL
Telangana	5	PGCIL
Gujarat	116	Railtel
Puducherry	100	Railtel
Tripura	65	Railtel
Total GPs to be covered in phase I by BSNL		84,366
Railtel		8,678
PGCIL		7,156
Total Number of GPs where OFC has been laid till March 7, 2016		42,892

In a letter to RailTel dated March 7, 2016, the DoT pointed out that its progress on laying down optical fibre cable (OFC) has been “very poor” and only 6,152 km has been laid even as optical fibre duct has been laid for 10,144 km.

“I do not need to over-emphasise the importance given to the programme by the PM. If the matter continues in this manner without any perceptible improvement in the progress as suggested above, the matter may be viewed seriously by the PM,” said the letter written by N Sivasailam, additional secretary, DoT.

While the government’s flagship NOFN project targeted to provide broadband connectivity to 1 lakh gram panchayats (GPs) by March 2016, it has now been deferred to December 2016. Minister of Communications and IT Ravi Shankar Prasad, however, told The Indian Express that the ministry is pushing for it and “the target would be met by the end of the year.”

But problems continue and there still seems to be question marks over the state-run executing agencies — Bharat Sanchar Nigam Ltd (BSNL), RailTel and Power Grid Corporation of India Limited (PGCIL) — meeting the deadline of December 2016.

Prasad said that the current government has made a big progress and has achieved much more than what was achieved by the UPA government. He said that as against 358 kms of OFC laid till June 2014, as on March 14, 2016 the optical fibre pipe has been laid in 53,584 GPs and the cable was laid in 42,892 GPs. But this still leaves around 57,000 GPs where OFC is still to be laid in less than 10 months for meeting the target of 1 lakh GPs.

While NOFN was planned in 2011 to connect all GPs through OFC and BSNL, RailTel and PGCIL were entrusted with the task of laying incremental fibre, the companies are running way behind their targets.

While BSNL has been entrusted with laying OFC in 84,366 GPs in the first phase, RailTel and PGCIL have to cover 8,678 and 7,156 GPs, respectively.

According to a report prepared by the Standing Committee on Information Technology that was presented in the Lok Sabha on December 21, 2015, while the OFC laid by the three state-owned companies till May 31, 2015 accounted for 20 per cent of their aggregate targets, RailTel made the slowest progress. While BSNL had laid 37,822 km of OFC accounting for 22 per cent of its target, PGCIL laid 3,110 km of fibre cable accounting for 14 per cent of its target. RailTel on the other hand had laid only 1,717 km of OFC accounting for just 8 per cent of its target. However, till March 7, 2016, Railtel had raised it to 6,152 km at a pace of around 500 km per month.

Earlier this month, Prasad had blamed limited resource deployment

by institutions as one of the key factors for not being able to meet the March 2016, timeline of NOFN project. In a written response in the Rajya Sabha, the minister said, “Considering the vastness of project execution, the very limited resources deployed by institutions, coordination with multiple agencies, time required for tendering, mobilisation of physical resources and the budgeted resources, the timeline for completion of NOFN project could not be met.”

Though the government may be confident of meeting the target of connecting 1 lakh GPs by December 31, there are stiff challenges that lie ahead for these companies. The DoT official, in his letter to RailTel, pointed that the company has to lay 8,000 kms of duct over the next 8 months which means 1,000 km per month and 400 kms of OFC per week. It also instructed the company to, “Discuss the matter with the contractors and increase the number of fronts where works are taken up so that trenching work is expedited to at least 300 km per week to increase the number of fronts where works are taken up.”

It is also important to note that even in Gujarat, which is the Prime Minister’s state and where BJP has been in power, the completion of project is way off the mark. While RailTel had been entrusted laying OFCs in the 5,735 GPs, as on March 7, 2016, the OFC laying was completed only in 1,859 GPs.

However, this is not the first time that the ministry has written to the organisation about the slow progress of work on the project. In February 2015, Prasad had written to railway minister Suresh Prabhu raising concern over the slow progress made by RailTel and asking him to review at his level. “I am writing this letter to share with you my serious concern over the lack of progress by RailTel in this important project. While RailTel was to have laid about 22,788 km of optical fibre cable before March 2015, I understand that the achievement so far is only 550 km; which amounts to roughly 2 per cent of the target. Consequently, as against the target of 8,106 GPs to be covered by RailTel by March 2015, only 260 GPs have been completed so far,” Prasad had written to Prabhu in a letter dated February 10, 2015.

A few days later, on February 27, 2015, Aruna Sundararajan, the then administrator, Ministry of Communications and IT wrote a letter to RK Bahuguna, CMD, RailTel, expressing concern over the progress made by the company. She went on to say in the letter that “The casual approach and disregard displayed by the top management and the officer s handling the project in RailTel is indeed regrettable.”

Initiated in 2011 the project was to be funded by Universal Service Obligation Fund with the aim of providing broadband connectivity to over 2 lakh GPs. It aimed to leverage the existing fibre optical network of Central utilities — BSNL, RailTel and PGCIL— and laying incremental fibre wherever necessary to bridge the connectivity gap between panchayats and blocks. BBNL was created as a public sector undertaking for its execution. While RailTel was allotted 8 states and 3 Union Territories, the company has shown progress in Tripura, Puducherry and Gujarat in terms of some connected GPs. There has been no progress in the remaining 6 states and 2 UTs.

The project, once complete, will enable the Centre to provide e-services and e-applications nationally and a minimum of 100 Mbps bandwidth is to be made available at each GP with non-discriminatory access to the network for all categories of service providers.

The Indian Express
23 Mar, 2016

Gujarat: Leak at Kakrapar N-plant ‘located & isolated’

The expert teams had earlier probed the radiation levels within the plant premises and outside in a 5-km radius.

The leak that caused scare around 10 days ago at Kakrapar Atomic Power Station (KAPS) in Tapi district was “located and isolated” by experts Tuesday, officials said.

The affected channel at Unit-I of the power station was located and isolated by a team of experts from KAPS, Atomic Energy Regulatory Board (AERB) and Bhabha Atomic Research Centre (BARC). Further investigation will now be carried out to ascertain the cause of the leak that occurred on March 11 in the primary heat transport (PHT) in one of the two 220 MWe units at KAPS, the officials said.

The expert teams had earlier probed the radiation levels within the plant premises and outside in a 5-km radius.

According to KAPS site director L K Jain, the core of 220 MWe pressurized heavy water reactor comprises 306 coolant channels made from the zirconium-niobium alloy, and each of those has 12 fuel bundles. The coolant flows through these channels transferring heat from the fuel to the steam generator to produce steam for driving the turbine to produce electricity, he added.

The teams had removed the fuel bundles from the identified channel with the help of sophisticated remotely-handled tools. The bundles had been carefully inspected and found to be intact. The affected coolant channel has since been isolated and the leak arrested.

Jain further said that no worker has been exposed to radiation. The radiological systems is at present in the normal state and cooling is been maintained in all the channels, he said, adding that the plant at present is in a "shut down state".

Sources said that the isolated channel would be now sent to either BARC or AERB to be ascertain the cause of the leakage. They also said other channels left at the site would be inspected by the expert teams to find out whether they were affected.

Deccan Herald
23 Mar, 2016

Laser method to create tiny smartphone batteries

Washington: Scientists have developed a new efficient laser-writing method to fabricate environment friendly, tiny energy storage units like microbatteries and micro fuel cells for smartphones and other hand-held devices.

In the race to design smaller devices and smartphones, a key factor is decreasing the sizes of components, researchers said.

As the demand for thinner and lighter microelectronic devices increases, manufacturers often are limited by how oddly shaped the energy sources must become to make them conform to the smaller space.

Researchers at the University of Missouri in US, have developed a method of transferring an energy source to virtually any shape.

"The direct laser writing (DLW) method and technique has seen a rapid advancement in the past decade," said assistant professor Jian Lin.

"The main goal of our research was to find an efficient and cost-effective way to integrate nanostructures with micro energy storage units for applications in micro-electronics," said Lin.

"Our lab decided to test whether catalysts could be synthesised and patterned on any surface by a one-step laser processing method to produce microbatteries and micro fuel cells in the shapes dictated by computer programmes," he said.

Researchers adapted the DLW method to synthesise and pattern hybrid nanocatalysts, or fuel sources, into complex geometric shapes.

Using computer-controlled laser writing that uses higher heat and pressure, the scientists were able to produce a surface that became electrically conducive and also has catalytic functionalities.

"This is the first step in manufacturing micro fuel cells that convert chemical energy into electrical energy and batteries that can integrate into microcircuits," said Lin. Also this technique has proven to produce microsupercapacitors.

Deccan Herald
23 Mar, 2016

New gravity map provides best view yet inside Mars

Boston: Scientists have created the most detailed map of Mars' gravity to date using data from three NASA spacecraft, providing a glimpse into the hidden interior of the red planet.

"The new gravity map will be helpful for future Mars exploration, because better knowledge of the planet's gravity anomalies helps mission controllers insert spacecraft more precisely into orbit about Mars," said lead author Antonio Genova of the Massachusetts Institute of Technology (MIT).

The improved resolution of the new gravity map suggests a new explanation for how some features formed across the boundary that divides the relatively smooth northern lowlands from heavily cratered southern highlands.

The team confirmed that Mars has a liquid outer core of molten rock by analysing tides in the Martian crust and mantle caused by the gravitational pull of the Sun and the two moons of Mars.

By observing how Mars' gravity changed over 11 years - the period of an entire cycle of solar activity - they inferred the massive amount of carbon dioxide that freezes out of the atmosphere onto a polar ice cap when it experiences winter.

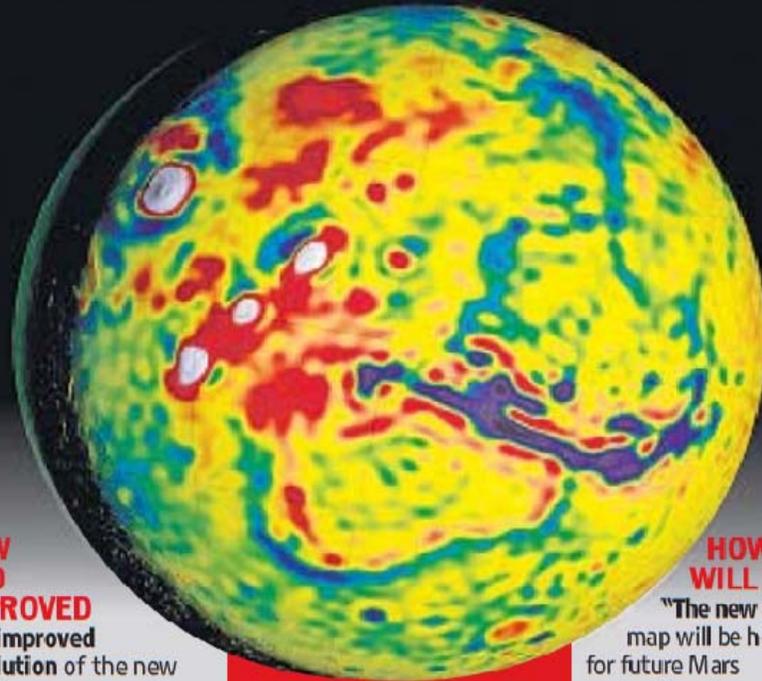
They also observed how that mass moves between the south pole and the north pole with the change of season in each hemisphere.

The map was derived using Doppler and range tracking data collected by Nasa's Deep Space Network from three Nasa spacecraft in orbit around Mars: Mars Global Surveyor (MGS), Mars Odyssey (ODY), and the Mars Reconnaissance Orbiter (MRO).

Slight differences in Mars' gravity changed the trajectory of the Nasa spacecraft orbiting the planet, which altered the signal being sent from the spacecraft to the Deep Space Network.

A MARS X-RAY

Scientists have created the most detailed map of Mars' gravity to date using data from three NASA spacecraft, providing a glimpse into the hidden interior of the red planet



NEW AND IMPROVED

The improved resolution of the new gravity map suggests a new explanation for how some features formed across the boundary that divides the relatively smooth north from the heavily cratered south

MARS' GRAVITY

Like all planets, Mars is lumpy, which causes the gravitational pull felt by spacecraft in orbit around it to change

For example, the pull will be a bit stronger over a mountain, and weaker over a canyon

HOW THIS WILL HELP

"The new gravity map will be helpful for future Mars exploration, because better knowledge of the planet's gravity anomalies helps mission controllers insert spacecraft more precisely into orbit about Mars," said lead author Antonio Genova of the Massachusetts Institute of Technology

OTHER OBSERVATIONS

The team confirmed Mars has a liquid outer core of molten rock by analysing tides in its crust and mantle caused by the gravitational pull of the sun and 2 moons of Mars

MARTIAN FACTS

AVERAGE DISTANCE FROM SUN

142 million miles

LENGTH OF YEAR

687 Earth days

LENGTH OF DAY

24 hours
37 minutes

GRAVITY

0.375 times that of Earth

HOW THE MAP WAS TRACED

The gravity field was recovered using about 16 years of data that was continuously collected in orbit around Mars

The map was derived using Doppler and range tracking data collected by NASA's Deep Space Network from three

NASA spacecraft in orbit around Mars: Mars Global Surveyor, Mars Odyssey, and Mars Reconnaissance Orbiter.