Increased awareness of the benefits and availability of donated breast milk has saved hospitals substantial amounts in treatment costs annually. Breast milk aids in combating infections in premature infants. The donated breast milk is pasteurised and stored. The pasteurised donor breast milk (PDB) is delivered on demand to NICUs in the SABR network to feed premature infants (registered with the SABR). The SABR’s current network is hampered by a lack of resources and an underdeveloped infrastructure. To improve its network structure, the flow of supplies and donated breast milk between the four main role players was standardised (as depicted in Figure 1).

SABR NETWORK EXPANSION PLAN
Unpasteurised donor breast milk (UDB) is donated by lactating mothers (screened and registered by the SABR) and collected and frozen at corners or milk banks. The corners subsequently send their UDB to the milk banks where all donor breast milk is pasteurised and stored. The pasteurised donor breast milk (PDB) is delivered on demand to NICUs in the SABR network to feed premature infants (registered with the SABR). The SABR’s current network is hampered by a lack of resources and an underdeveloped infrastructure. To improve its network structure, the flow of supplies and donated breast milk between the four main role players was standardised (as depicted in Figure 1).

Figure 1: Proposed SABR network design

This will simplify the network dynamics significantly and enable the implementation of a uniform and duplicable transportation solution. To realise its expansion goal of building a sustainable, breast milk banking network across the entire South Africa, the SABR is developing a franchise-like strategy in terms of which it remains the owner of the business concept while spreading the workload across a decentralised network of corners and in-hospital milk banks. The first step would be to establish SABR corners and assign these to existing milk banks in order to create resource capacity and stabilise the existing network. This model can then be duplicated across the provinces until the SABR’s reach.

CORNER SITE LOCATION
A mathematical model was developed to determine the number of additional corners required and appropriate locations to place these corners in the SABR network’s expansion. The model, based on the second Maximal Covering Location Problem with Spatial Objects (MCLP-SO3), presented by Alexandris and Giannikos [2010], attempts to maximise the total coverage of a specified number of facilities over varying demand areas.

To illustrate its functionality, the MCLP model is applied to Gauteng to determine where new corners should be established to serve potential donors.

To transform the available data into the format required by the model, two pre-processing stages are performed. The first stage determines the coverage of donor clusters by potential corner locations and the second, the potential donor density of each cluster. Two donor cluster grid sizes are considered to investigate the model’s sensitivity to grid size when all else is kept equal.

RESULTS
The model was solved using LINGO 10.0 optimisation software. A sensitivity analysis was performed for both grid sizes to determine the impact of the number of corners allocated on the potential benefit realised through increased coverage. The results show that increasing the number of corners increases the total benefit at a decreasing rate. The decision-maker must decide at which point the increase in total benefit no longer justifies the investment required to establish and maintain an additional corner. Furthermore, the results confirmed the model’s inherent sensitivity to grid size.

In the case of Gauteng, smaller grid sizes ensure greater coverage in densely-populated areas, whereas the larger grid sizes tend to spread the coverage across the province. The decision-maker would have to decide which is more suitable.

WAY FORWARD
Before expanding the MCLP model to the rest of South Africa, data used to determine model parameters can be refined. Furthermore, refining the demographic assumptions made regarding potential donor density.

Subsequent network planning involves the selection of an optimal transportation alternative, strategic milk bank establishment, inventory planning and capacity planning. Once completed, a detailed implementation plan must be developed to inform the roll-out of the network.

Finally, the problem-solving approach followed throughout this research, and particularly the implementation of the MCLP, can be used to address similar network planning problems where supply must be gathered in small quantities from geographically dispersed donors.

The research approach can be used for similar network planning problems where supply must be gathered in small quantities from geographically dispersed donors.